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ABSTRACT

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THE EFFECTS OF A SELF-INSTRUCTIONAL CURRICULUM TECHNIQUE ON RETENTION AND UNDERSTANDING

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HEALTH, EDUCATION, AND WELFARE

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National Center for Educational Research and Development
(Regional Research Program)

PREFACE

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CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction to the Problem

For many years, since the time when Behaviorism first became a strong influence in psychology, the study of learning has dealt primarily with the influence of external stimulus variables on learning and retention. Only recently have psychologists and educators once again begun studying the influence of the cognitive activities of the learner on what he is able to remember at some later time. These are part of a class of activities Rothkopf (1970) has called "Mathemagenic Behaviors," which he has defined as " . . . those student activities that are relevant to the achievement of specified instructional objectives in specified situations or places." Included under this definition are internal processes such as set, information processing, rehearsal, etc., all of which have a direct bearing on retention.

A large body of contemporary psychological research suggests that the way a person organizes information in learning it is an important "Mathemagenic" activity determining what and how much of the information he can later recall. Endel Tulving (1962) has called this internal coding or organization a learner imposes on verbal material "subjective organization."

Mandler (1967) and Mandler and Pearlstone (1966) have developed a sorting task by which the effect organization has on memory can be studied directly. In their research, students were required to sort cards, each bearing a single word, into piles of their own choosing, placing related words together. Sorting trials were continued, with the cards shuffled on each trial, until the student sorted the cards into the same piles on two successive trials. At this point, Mandler assumed that they had established a stable organization of the set of words. Then, or at some later time, the subjects were required to recall as many of the words as they could remember in any order they wished. A strong linear relationship was found between the number of piles the students used in sorting (up to a maximum of seven) and the number of words they could recall. Most striking was the degree of difference produced by this variable. Students sorting into seven

piles could recall twice as many words as those sorting into two, even though the amount of time spent in sorting did not differ significantly. This relation between organization, as defined as the number of category piles used in sorting, and recall appears to be one of the strongest effects yet identified by psychologists studying human learning and memory processes. This phenomenon will be referred to in this report as the Mandler Effect.

An important implication of Mandler's research is that the task can influence the organization a person imposes on a set of information, and thus influence his ability to recall the information. It appears that by utilizing Mandler's task, the interesting activity of organizing information can be studied and to some extent controlled. However, there are certain limitations of the studies done so far which point the way to additional needed research. First, all the work which has been directly related to the study of organization and its effect on memory has used word lists as stimulus material. No one has yet clearly demonstrated that the relation between organization and recall is obtained when more complex materials such as prose are used. Secondly, previous research has used a very few task variables in investigating their effect on secondary organization and retention. For both practical and theoretical reasons, this research needs a great deal of expansion.

Recently the Educational Research Group of the Centre for Structural Communication located at Kingston-upon-Thames, Surrey, England has developed a self-instructional technique designed specifically to aid the student in organizing the concepts and facts in a prose study unit. They have called the technique Structural Communication. Besides its pedagogical promise, this technique is of interest because it has clear parallels to the research dealing with organization and memory. In fact the curricular materials prepared for Structural Communication make it possible to test quite directly whether the variable found by Mandler to influence recall from word lists has a similar effect on retention and recall of the major facts and concepts of a prose passage. Furthermore, the method has embedded in it new task variables which may influence the way students organize and retain written discourse.

The present research is generally an extension of the organization and memory literature for the purpose of assessing its relevance to complex classroom learning. There are three objectives of this study: (1) to determine whether the way a student organizes the concepts and facts of prose study units affects his recall as psychologists have found with word lists; (2) to evaluate the organizational aspects of the new self-instructional curriculum technique, Structural Communication; (3) to determine the effect of several task variables on the subjective organization and subsequent recall and use of prose information.

This chapter will review psychological research which illustrates the importance of subjective organization for later recall, and a theory of how organized information is retrieved. It will also present an elaboration of the Structural Communication technique, the theory and assumptions underlying it, and its relation to the organization and memory literature. The chapter will conclude with a brief rationale for the studies described in this report.

Review of the Organization and Memory Literature

Within the last twenty years there has been a resurgence of interest in human memory processes. During this time much significant research has been done which sheds light on how people remember and recall information. One of the most productive research areas has been the study of free recall.

The free-recall paradigm permits the subject to recall previously presented items in any order he wishes. Usually certain regularities appear in the subject's recall protocol. There is a tendency for subjects to recall items together which are objectively or subjectively related to one another, even though they are separated during presentation. The tendency for separated items to be recalled contiguously is used as evidence for inferring organizational processes on the part of the learner. This "subjective organization" is believed to be a necessary if not sufficient condition for recall by most investigators in the area (Kintsch, 1970; Tulving, 1968; Mandler, 1967, 1968a).

In this section the research will be reviewed which suggests that such organization does exist, that it is quantifiable, and that it may be a necessary condition for retrieval of information from memory.

Clustering research. In the early research on organization of free recall, the experimenter prepared a set of words which he conceived as consisting of two or more mutually exclusive subsets of items. Individual items in the same subsets were assumed to be more related to each other than to items in any of the other subsets. The subsets were usually defined as consisting of items which either belonged to the same conceptual category or were associatively related. All the items in all the subsets were then presented in random or quasi-random order. Organization was assumed to have occurred if subjects recalled related items in immediately adjacent output positions more frequently than would be expected by chance (Tulving, 1968). These sequences of related words were referred to as clusters.

A study by Bousfield (1953) gave impetus to the study of organizational variables on recall. In this study, subjects were given a randomized list of 60 words which consisted of four 15-word categories. Immediately after presentation, the subjects were given 10 minutes to write all of the words they could remember in the order in which they were remembered. The results indicated a greater than chance tendency to recall items in groups or clusters which contained members of the same general category. Bousfield suggested that this category clustering was a consequence of the activation of superordinates by the items presented. These superordinates then supposedly mediated the emission of the items during recall.

Later studies have confirmed the phenomenon of category clustering and have related it to the number of words recalled (Bousfield and Cohen, 1953; Bousfield, Cohen and Whitmarsh, 1958; Cofer, Bruce and Reicher, 1966). The Cofer paper reported a series of experiments involving category clustering in lists composed of words which were given with high frequency (HF) or low frequency (LF) when subjects were asked to list members of a category. The presentation sequence was varied by presenting the items from different categories either in a blocked (words from each category being grouped together) or random order. The results showed that blocked presentation augments the number of items recalled only in the HF list. Number of words recalled and clustering were both higher when HF lists were used. These investigators also computed correlation coefficients between Bousfield's (1953) index of the degree of clustering, called the ratio of repetition (RR), and the number of words subjects recalled. RR is calculated by subtracting the number of clusters from the number of clustered words in a given subject's recall protocol, and dividing the result by the number of words recalled minus one. This yields the number of times the subject recalled two related words together as a proportion of the number of times this could have occurred. Recall was found to be positively correlated with clustering in all but one of the conditions.

Other researchers (Jenkins and Russell, 1952; Jenkins, Mink and Russell, 1958; Deese, 1959) have found that associatively related items presented in random fashion during input also tend to cluster at output at a level greater than chance.

In most of the clustering studies, a large proportion of the items used in the stimulus lists were not only categorically related to one another, but were associatively related as well. Therefore, it is not clear whether the clustering of verbal responses in these studies should be explained on the basis of simple associations between words in the lists, or whether it is necessary to invoke the additional principle of superordination. Marshall (1967) has produced evidence that when the association among list members is held

constant, the role of category membership is still important for recall. In his experiment II, Marshall computed associative overlap scores for the words used in his experimental lists. This index is a comprehensive measure, which includes all of the associations which two words commonly share, expressed as a proportion of all their respective associations. Six groups of subjects were then presented with lists of 24 items in random order. Each list contained six categorized pairs and six non-categorized pairs, with all pairs in each list equated on associative relatedness as measured by the overlap scores. Each group was given four learning trials on one of the lists, with the words in a different order on each trial. The results indicated that when association strength between pair members was equated, word pairs that belonged to the same category were recalled more frequently than non-categorized pairs. Marshall also provided evidence that recall and the amount of clustering are positively correlated.

In summary, it appears that if the stimulus material contains words which are related either categorically or associatively, clustering tends to occur and recall improves. The research indicates that humans are somehow able to utilize the structure inherent in the list during learning and/or recall.

Subjective organization. A major disadvantage of the measures of the amount of clustering is that they only tap organization of the type for which the experimenter is specifically looking. The relations among the items in the list are defined by the experimenter, and the obtained measures of organization are dependent upon the degree to which subjects recall in sequence exactly those words the experimenter identified as being related. Tulving (1968) argued that subjects not only use organization in the list that is apparent to the experimenter, but they also tend to find their own idiosyncratic relations among words in the list. Thus, clustering experiments tend to underestimate the extent of the total organization a subject imposes on the list during learning and utilizes during recall. If one wants to include this aspect of subjective organization in his research, it could be argued that: (1) material would have to be presented to subjects as nearly free of any apparent organization as possible; (2) because these words are supposedly not related, it would be necessary to present lists more than once, so that evidence for such organization could be obtained; and (3) it would be necessary to present the items in different orders on each trial in order to avoid the charge that any clustering which might occur was due to contiguity (Tulving, 1962).

Tulving (1962) tested these notions by devising a method for measuring the degree of organization subjects impose on a list of supposedly unrelated words. The experimental procedure consisted

of presenting subjects with lists of "unrelated" English nouns. Sixteen different sequences of these words were constructed such that, considering any block of the stimulus list, there was not any apparent organization in the presentation orders. No item was adjacent to any other item more than once. Subjects were then given sixteen trials with the sixteen reordered lists with a recall test following immediately after each list presentation. The data showed that on successive trials the subjects tended to recall the words in much the same order. Tulving assumed that this grouping in recall reflected an underlying stable organization, and developed an index to measure it (SO). He found that both recall and SO increase over trials and that they are highly correlated. This result was later confirmed by others (Bousfield, Puff and Cowan, 1964; Tulving, 1966).

In all of these studies as with the clustering studies, recall was assumed to be dependent on subjective organization because of the correlation between measures of organization and the number of words recalled. Correlation, however, does not necessarily imply that one variable causes the other to occur. They may both be the result of a third factor, which produces the covariation.

Several recent studies weaken this criticism (Tulving, 1966; Tulving and Osler, 1967; Bower, Lesgold and Tieman, 1969). Tulving (1966) reasoned that if it were true that recall is just a function of subjective organization formed, and not of repetition per se, then if it were possible to inhibit the development of subjective organization, repetition would have little or no effect on recall. On the other hand, if recall is primarily a function of repetition, the number of words recalled should increase as a result of repetitions whether or not the learner was subjectively organizing the words. The experiment used to test these assumptions was a typical multi-trial free recall design with twelve trials for each subject. The only difference between the two experimental groups was in the treatment given prior to learning the list. Both groups were given a prior task of reading a list of word-letter pairs for six continuous trials. For the prior acquaintance group, the words in these pairs were words from the list to be learned. The no prior acquaintance group had pairs of male names and random numbers. Both groups read pairs out loud as they were presented on a memory drum. By the end of this task the subjects in the prior acquaintance group had seen and responded to each word of the experimental list six times, whereas the other group had not seen the words. It was assumed that the reading task prevented the prior acquaintance group from organizing the stimulus words. The subjects were then given a series of learning trials on the word lists. The results showed no difference in the learning curves for the two groups. Tulving concluded that mere repetition is not sufficient to increase recall. Repetition is effective only when it leads to the formation of subjective organization.

Number of categories and its relation to recall. Some of the most important research relates the form of subjective organization to recall. Specifically, it deals with the number of categories subjects used to organize a set of words and how many words they can then recall from the list.

Early work indicated that when subjects are given lists with categories built into them, recall is a function of the number of categories in the list (Dallet, 1964). Work by Cohen (1966) and Tulving and Pearlstone (1966) indicates that when list length is varied but category size is held constant, the average number of words recalled from each category will be constant if the category is recalled. Thus the total number of words recalled is primarily a function of the number of categories remembered.

In all of these studies, it was assumed that subjects organized the lists according to the experimenter-defined categories. They, like the other clustering studies, tend to underestimate the total amount of subjective organization which subjects impose on the material because they relate recall only to these experimenter-defined categories.

Recently Mandler (1967, 1968b) and Mandler and Pearlstone (1966) introduced a task that permits subjects to organize the material themselves and which allows for the study of the effect of the number of subject imposed categories on recall. The study by Mandler and Pearlstone will serve as an illustration of the task, as well as providing further evidence for the importance of subjective organization for recall.

These researchers argued that in most concept (or category) learning experiments, the task forces subjects to learn the categories which have been determined by the experimenter. This not only hides any idiosyncratic organization established by the subjects, but may also present subjects with an interference paradigm. If the subject's conceptualization or organization is not identical to the experimenter's, then a subject must suppress or ignore his own system in order to complete the task. Because this activity takes time it may interfere with learning.

The experimental task consisted of asking two groups of subjects, free and constrained, to sort lists of 52 words into categories. Each word of the list was printed on a separate 3 x 5 inch card, thus forming sorting decks. Subjects sorted successive decks, each containing the same words in a different random order, until they were able to sort the cards into the same piles twice in succession. Members of the free sorting group were allowed to use from 2 to 7 categories and to use any system they wished as the basis for

sorting the cards. Each subject in the constrained group was required to learn to sort the cards into exactly the same piles as a yoked partner from the free group. Upon reaching the sorting criterion, all subjects were required to recall as many of the words as they could in any order they wished.

The results showed that constrained sorting takes more time than free sorting, thus supporting the hypothesis that forcing a subject to learn experimenter-defined categories is interfering. Although the constrained group took more trials, once criterion was reached recall was the same for both groups. The major finding was the relation between the number of categories used by the free subjects and their recall. Recall was an increasing function of the number of categories used in sorting. This same relation was found for the constrained subjects who reached criterion.

Mandler (1967) examined many parameters affecting the relationship between the number of categories used in sorting (NC) and recall (R). Basically he used the same task as Mandler and Pearlstone with the exception that no constrained subjects were used. A series of experiments were run which varied the type and number of words used in the lists, and whether the subjects were free to choose or were assigned the number of categories to be used in sorting. The median value of the correlations between NC and R for the experiments was .70, again stressing that NC is an important variable for recall. The experiments demonstrated that this relationship between NC and R is a robust finding, being obtained when: (1) words of high or low cultural frequency are used; (2) the length of the list varies; (3) subjects are assigned the number of categories they are to use in sorting; (4) and time and trials are held statistically and experimentally constant. These findings have been replicated by others and seem to be reliably obtained using similar experimental procedures (Mandler, 1968b; Mandler, Pearlstone and Koopmans, 1969; McConkie and Dunn, 1971; Dunn and McConkie, 1971).

Most studies which have used Mandler's task to study secondary organization have used word lists which did not contain any apparent internal structure. An exception to this was the Dunn and McConkie (1971) experiment. One of their groups sorted lists which contained conceptual categories drawn from the McConkie and Dunn (1969) word sorting norms. Subjects were assigned the number of categories they could use to sort the list, but were free to place the words within the categories using their own system. The results showed that the relationship between categories and recall is still obtained when subjects sort conceptually organized lists; thus, the effect is not limited solely to the use of "unrelated" stimulus material.

Advantages of the Mandler sorting task. A major weakness inherent in the tasks of the clustering and SO studies, including Tulving's, is that measures of subjective organization can only be derived from data obtained at the output phase. Therefore, it is impossible to assess the organization already existing in the subject's mind at the time of input, and whether subjects organize the words during learning or only at the time of recall. The task described by Mandler circumvents these problems.

By using the sorting task, one can see how subjects first place the items into categories. This initial card placement may be indicative of prior subjective organization. Changes in card placement over sorting trials may indicate changes in that organization. It also provides a means by which the organization formed by the subject during sorting (input) can be directly related to recall (output).

As shown above, when the number of categories used in learning increases, recall increases. This suggests that organization occurs at learning, and that it then influences retrieval. If it is to be said that retrieval is based on that organization, however, it is necessary to show that items contained in the categories formed during learning tend to cluster together at recall and that as more of these categories are used, clustering and recall subsequently increase. Mandler (1967) provided such evidence by using the mean ratio of repetition (RR) developed by Bousfield (1953) to measure clustering. It is defined as R/(N-1) where R is the number of times a word from a category follows another word from that category and N is the total number of words recalled. Mandler computed random, maximum and obtained RR scores for the large groups of subjects in his stody. The random RR value was determined by randomizing each subject's recall protocol, then computing the RR value for the words in that random order. The maximum value was found by calculating the RR value which would be obtained if each subject had recalled the words in each sorting category as a single cluster. The obtained mean ratio was simply the RR value for the recall sequence in the order each subject emitted it. Mandler found that as the number of categories used by subjects increased, clustering also increased. Subjects' actual RR values moved away from the amount of clustering which would be predicted by the random model and closer to the maximum value of RR as they used more categories in the sorting task. Thus it appears that the categories formed during sorting do indeed provide the basis for recall.

Several explanations of this phenomenon suggest themselves. It is possible, for example, that when subjects sort into more categories they abstract (or form) more retrieval cues than when they sort into fewer categories. At the time of recall, they would

have more memory aids (cues) which would help them recall more items. If these cues are "superordinate" category names, as Bousfield's and Mandler's work suggests, then subjects would tend to recall the words within a given category together. Thus one would expect clustering (as well as recall) to increase as more categories were used, and that this would be indexed by RR.

A slightly different possibility is that sorting into more categories compels a subject to process the material more extensively and thus produces a greater absolute amount of subjective organization. (Note that this differs from abstracting retrieval cues.) This "greater" amount of organization (which would also be indexed by RR) would then help the subject to retrieve more items at recall.

Clearly, another alternative is that both these possibilities are operating when subjects sort into increased categories. Unfortunately the present state of research does not permit evaluation of these alternatives.

Regardless of which explanation is the most adequate, Mandler's work stresses the importance of organization for recall. These results, coupled with the experiments of Tulving and his associates, provide strong evidence that subjective organization may be a necessary condition for recall to occur. These investigators, as well as others, have argued strongly for this exact point (e.g., Mandler, 1967, 1968a; Tulving, 1968; Kintsch, 1970).

Of the methods discussed thus far, Mandler's sorting task has some definite advantages for studying the effects of subjective organization because it permits subject-formed categories to be observed and to be directly related to recall using clustering indices. For this reason it was used as the experimental task in the research conducted for this report.

A model of retrieval of stored information. Thus far evidence has been presented which suggests that subjective organization is a necessary and perhaps sufficient condition for retrieval of information from memory, but there has been little discussion of how the information is retrieved and what mechanisms are involved. Various models of retrieval have recently been proposed. One developed by Mandler (1967, 1968a) will be discussed in detail.

Mandler based his model of retrieval on the notions presented by Miller (1956). Miller notes that the span of absolute judgment and the span of immediate memory constrains the amount of information that humans can handle at once to about 7 ± 2 items. Obviously, we do remember more than seven units of material at one attempt. Miller postulated that by grouping or organizing input into units or

chunks, we can increase our capacity to store information. This process of organization involves recoding the input material into new and larger chunks. Recalling a set of items involves the retrieval of a limited number of chunks, about seven, and the decoding of the contents of those chunks. Although only a few chunks can be recalled, the total number of units of information within each chunk is apparently unlimited.

Mandler (1967, 1968a) argued that the limitation on memory can be overcome by arranging the chunks (categories) hierarchically. Thus some categories become the chunks of a larger category and some of those larger categories become chunks for a "super" category. Mandler argued that each chunk can contain 5 ± 2 items, and that there can be five such levels in the hierarchy. Retrieval is seen as an active search process with the organized units of categories serving as retrieval cues. Therefore, if an item is to be retrieved it must be organized into such a structure. Mandler assumed that during learning in a typical free-recall learning experiment, a subject first organizes words into the existing categories and hierarchies in his permanent storage. If the existing organizational system cannot accommodate the items in the new input, he forms new hierarchies which are organized for retrieval. These newly formed sets are transient and do not survive for more than a few minutes or few hours unless they are utilized again (Mandler, 1968a, p. 114). Therefore, failure to remember an item can be due to either not organizing it during learning, or loss of the fleeting "unexercised" category of which it was a member. Note that retrieval from this system is highly dependent on the organization formed at the time of learning.

Structural Communication

Assumptions. The Structural Communication curriculum technique is based on certain theoretical assumptions. Foremost is the assumption that a plurality of levels of mental operation exist. The developers postulate four levels of operation: creative, conscious, sensitive and automatic. The creative level is characterized by unexpectedness, spontaneity and a lack of conscious reasoning. It is the highest level of functioning and the hardest to train, if such training is even possible. The next level, the conscious, occurs infrequently in human functioning. Unlike the "creative level" this level clearly can be trained. It is defined as " . . . integrative awareness or the power to apprehend and judge a multiplicity of separate ideas or presentations" (Systematics, 1967, p. 229). Such things as understanding, hypothesis-formation, unbiased judgment, and impartiality are included in the conscious level. The level of sensitivity is analogous to the ordinary waking state of man. When one is operating at this level, there is a restricted awareness of immediate experience. The mental activity is predominantly associative and, although complex binary operations can be performed, no more than two distinct ideas can be operated on at any given moment in time. The authors state:

> Education today is directed mainly to training the mental and bodily operations that are associated with the sensitive level. Logical thinking, experimentation and the observation of nature, self-expression in word and symbol, adaptive and purposeful activity are all possible on the sensitive level of operation; but do not generally require the intervention of the conscious level except for self-appraisal . . . . In a very broad sense, it can be said that we know all that we need to know for the purpose of human existence by means of operations in the sensitive level. (Systematics, 1967, p. 230).

The level of automation contains those unconscious operations which sustain all animal and human activity. Included are the learned processes of imitation and repetition and any innate processes the organism possesses. Sometimes the automatic functions must first be learned at the sensitive level, and when thoroughly learned can pass into the unconscious or automatic level. An example would be language learning. At first one must consciously struggle to memorize the grammar and vocabulary. Later on, however, the process of speaking or writing in the language becomes automatic.

A method for raising the level of mental operation of a subject is to provide either a shock or challenge which arouses his

attention. A shock is seen as a traumatic experience or deconditioning procedure by which a person is released from a learning set or from learned patterns of association. It has certain important features. The most prominent are its unexpectedness and the difficulty of "making sense" of its consequences. A shock to the mind can have undesirable pedagogical consequences as is illustrated by a story provided by the authors:

> In student groups subject to unstructured deconditioning, there is clear evidence of a reversal of the initial good intentions. For example, in art college the lecturers took the students' design work at the end of the first year and deliberately criticized it violently as useless imitatory rubbish. The students were then set free from formal instruction and encouraged to experiment in as wild a fashion as possible. The end result was that the students were aping the styles of the lecturers themselves! (Systematics, 1967, p. 238).

A shock then is simply an impact that may or may not have any positive intention or result. A challenge, on the other hand, is seen as an obstacle, placed either intentionally or by accident, which can be overcome only by increasing determination and a higher intensity or level of mental operation. An effective challenge has to meet the recipient at the right time and place.

Any situation or communication is assumed to have structure. The structure consists of a knowable and an intelligible content. The knowable content is the information or subject matter, and the intelligible content is the ideational component or theme of the communication. These definitions imply that the theme transcends mere information in the physical stimulus and has metaphysical properties. The Method of Structural Communication is based on the hypothesis that, although the knowable (subject matter) and ideational (theme) components of a structure are contained in the same whole, they are not identical. Because of this, it is possible to transmit knowledge without understanding, and yet it is also possible to structure the same knowledge (subject matter) in a way to produce an experience which will lead to understanding. These ideas are similar to those Dewey (1938) expressed in Experience and Education, where he argued that traditional teaching methods impose subject matter on students and stress rote memory of the material rather than understanding of the underlying structure of the subject matter. He argued that true understanding could only occur when the learning situation was structured in a way which permits an interaction between the subject matter and the student's own experience; thus he also believes that knowledge per se can be transmitted without understanding.

The developers of Structural Communication state that the subject matter can be learned at the automatic level of functioning, whereas the theme or the spirit of the message is grasped at the consious level of the mind. When both are brought together on the sensitive level, the recipient both knows and understands the structure in question (Systematics, 1967, p. 242). Effective learning or communication is not possible unless the communication is completely structured, by having the parts integrally related to the whole. This point is important because the main element of Structural Communication, the study unit, is assumed to be structured in this manner. Given this theoretical background, the technique which grew out of it will now be described.

Outline of the Structural Communication Method. According to Egan (1971) the basic element of Structural Communication is the study unit. Contained in the study unit is a subject matter which can be effectively communicated (learned) in a single continuous session of work. It is usually comprised of a small booklet of ten to twenty pages and is divided into six parts. Figure 1 names these parts and illustrates the typical sequence a student utilizes when interacting with a study unit.

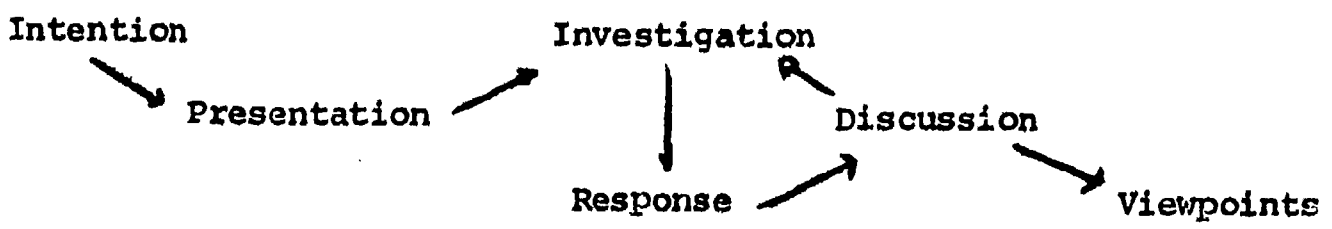

Fig. 1. Sequence of steps through a study unit.
(Taken from Egan (1971) with permission of the author.)

Each of these sections plays a different role in communicating the subject matter and the theme of the passage. The communication involved is seen to be a form of dialogue between the author and the student. Appendix A contains a complete study unit as an example of this method. The role of each section is given below, and, where possible, will be related to the theory behind its conception.

1. Intention--This section outlines the theme of the study unit to be developed by the author.

2. Presentation--This contains a carefully structured presentation of the subject matter and theme of the communication.

Careful structuring is important because, according to the theory, structure is a necessary condition for understanding.

3. Investigation--This part contains three to five challenges about the subject matter which are put to the reader. Each challenge consists of a rather complex question about the passage which tends to cut across the subject matter as a whole. Examples of challenges can be found in the study unit in Appendix A. They will be explained further after describing the next part, the Response Indicator.

4. Response Indicator--This section contains a listing of the main concepts and facts contained in the Presentation. They are typically arranged in the form of a matrix which contains up to 30 items, with each assigned a number for easy identification. The items are arranged randomly in the matrix. Egan (1971) states:

> . . . As 'de-structured' in the matrix, these items constitute a random 'semantic field', but they are organized (by the reader) in relation to the problems (challenges) in such a way that when viewed 'through' each problem (challenge), an undetermined number of items may be put together to form a coherent whole, an answer, a satisfactory response. The same item may be selected as part of a response to one, two, three or more problems and, if the unit is well structured, it will play a different role in each.

Thus, in solving the problems posed by the challenges, the student is required to consider each of the basic concepts and facts of the Presentation, as contained in the Response Indicator, and determine whether each is an appropriate answer to the challenge or relates to the question posed by the challenge in a specified way. He answers by writing down the numbers of those items from the Response Indicator which he feels meet the criterion specified by the challenge. In this way he considers each of the basic concepts and facts of the passage several times, each time from a different frame of reference. This presumably causes him to interrelate the important parts of the passage in different ways.

The idea of presenting a challenge comes directly from the theory behind Structural Communication. It is assumed that by presenting a challenge to the reader one can cause him to move to a higher level of mental functioning, usually the conscious level, and thus facilitate true understanding. It is in the interplay between the Investigation and the Response Indicator that the transition from "knowing" to "understanding" begins (Systematics, 1967).

5. Discussion--This section consists of two parts. The first part, the Discussion Guide, provides a means by which the student

processes his own responses to the challenges. Here the student is given a guide by which he can begin to have a dialogue with the author. He compares the numbers which he wrote down as his answer to each of the challenges with a listing of the numbers selected by the author. The second part of the Discussion, the Discussion Comments, is organized in such a way that the student can receive an explanation for each of the author's choices for his own answer. Thus, if the student leaves out certain numbers which the author included, he finds an explanation for why the author included them. On the other hand, if he includes items in his answer which the author did not, he finds the author's justifications for why he left them out. Sometimes the comments are used to expand the theme of the author, and even though the student responded correctly he is directed to a comment that further elaborates the point being made. The developers of the technique state that this section also aids the achievement of understanding, although little is said specifically about how they believe this is accomplished.

6. Viewpoints--In this final section the authors reflect and state their biases explicitly and sometimes direct the student to other writers whose opinion on the subject differs from theirs (Egan, 1971).

In summary, it is claimed that Structural Communication is a self-instructional technique which not only conveys facts but develops "understanding" as well. It does this by presenting highly structured material which challenges the recipient to answer questions posed by the author, and by promoting a dialogue between them. It is assumed that a student's understanding can be inferred " . . . if a student shows the ability to use knowledge appropriately in different contexts, and to organize knowledge elements in accordance with specified organizing principles" (Egan, 1971).

Relation of Structural Communication to the Organization and Memory Research

The Structural Communication study units are of particular interest for several reasons. First, each unit provides a set of prose where the main facts and concepts have been identified and presented in the Response Indicator in a form by which it is possible to investigate organization through card sorting. Second, the task embedded in the technique, that of providing a student with a challenge and asking him to indicate which cells of the matrix serve as appropriate answers, is strikingly similar to the two-pile sorting condition used by Mandler. In both cases, students are asked to sort a set of items into two categories. It was felt that the cells in the Structural Communication matrix could be reproduced on individual cards, and the student asked to sort the cards into one pile

of items which appropriately answer the challenge and another pile of items which do not. This seems to parallel the authors' previous experience with two-pile sorting using word lists in which students often report that they used a criterion for one pile (e.g., people-related words) and then put all other words in the other pile. Third, there is an interesting difference between the challenge-and-matrix task and the card sorting task used by Mandler. When using the Structural Communication technique, students sort each of the items according to several different questions (challenges). Thus, the same set of information is divided along different lines on subsequent trials. In the Mandler sorting task, however, the student attempts to sort items into the same discrete piles on each trial, thereby reaching a single stable organization. These two tasks need to be compared to examine their relative effectiveness in providing for later recall.

Although recall of material is important, Bruner (1960) has argued that simple recall is of limited use to the student. He feels that it is necessary for the student to develop an "intuitive understanding" of the subject matter that will enable him to answer new questions and solve new problems. As we have seen, the creators of Structural Communication claim that the technique does in fact accomplish this. Clearly, this needs investigation. For this reason, the main experiment of this paper includes an essay test, using a problem the students had not previously seen.

It is important to note that the only portions of the Structural Communication method that the present research specifically investigated were those from the Presentation, Investigation (challenge) and Response Indicator (matrix) sections which are related to organizing the main ideas from the passage. Thus, the present research does not provide an adequate evaluation of the Structural Communication method as a whole.

Rationale and Summary of the Studies Carried Out

Pilot experiments. The first series of three experiments to be reported were originally intended to be a means of trying out and improving the general experimental procedure to be used in the main experiment. They were designed to provide information on the first objectives of the main study, namely, whether the number of categories used in sorting affects the amount of information students recall when prose is used as the stimulus material. The results of these experiments proved to be interesting in their own right, and suggested changes in the proposed design of the major experiment. Because of this they are reported in detail.

The three pilot experiments were essentially a replication of Mandler's research, but with the items sorted being statements from the Response Indicator of a Structural Communication study unit rather than words. Subjects were assigned the number of piles to use in sorting, and they continued their sorting trials until they reached a criterion of two identical sorts. They then recalled as many of the statements as possible. Scoring was on the basis of the substance of the ideas in the statements, rather than a word-for-word recall. In the first two studies the statements sorted were taken quite dirctly from the Response Indicator, with changes to make each item a complete and comprehensible statement. For the third study the statements were changed slightly in a way so as to destroy many of the interrelations which existed among them.

Main experiment. The main study was designed to provide information on three topic areas. These were: (1) to determine whether the relation between the number of categories and amount recalled is obtained when prose rather than word lists is used as stimulus material; (2) to examine the effects of selected task variables on the formation of subjective organization during learning and the relation of that organization to recall; (3) to evaluate the organizational tasks inherent in the Structural Communication technique by examining their effect on students' recall and their use of the material as measured by essay tests.

Eight groups of high school students were each presented with information from Structural Communications study units under different conditions. Some were given one or more challenges and sorted modified Response Indicator items on the basis of these. Others, some of whom had read the Presentation, sorted the modified Response Indicator items into specified numbers of piles according to their own criteria. Other groups simply read the passages and were not asked to sort the Response Indicator items. All groups were asked to recall the main points of the study, as indicated by the items in the Response Indicator, and were given a question upon which they were asked to write an essay. Study units used were on different topics: history, economics and botany.

After describing the experiment and presenting the results, the findings will be discussed in terms of implications for psychological theory and for educational practice.

CHAPTER II

PILOT EXPERIMENTS

The following three experiments were designed to extend the organization and memory research by investigating the relation between number of categories (NC) used in sorting and number of units recalled (R) when meaningful prose is used as the stimulus material. A task similar to the one employed by Mandler (1967) was utilized throughout, but with sentences as the stimulus items to be sorted and recalled. The general method used in all experiments will be described first, followed by a description of each experiment separately.

General Method

Materials. The Presentation sections of two study units were used for these experiments, one of which was provided by the Centre for Structural Communication, and the other was developed specifically for this research. The topic of the first passage was English History, which dealt with the life and reign of Mary Tudor. The second passage was taken from a text on botany by Coulter and Dittmer (1964). It was chosen because of its similarity to the Presentation sections contained in Structural Communication study units. Booklets were constructed by dividing each of the passages into sections of approximately 160 words each, with each section printed on a separate page. Each unit contained approximately 2700 (± 200) words. Both booklets are reproduced in Appendix B.

Previous work (Amato, 1970) has shown that the statements of the main points which are provided in the Response Indicators of Structural Communication study units tend to be too long and complex to be used in an experiment requiring their recall, so another means of specifying the main points of each passage had to be found. The technique used to determine main points in the History passage (the only passage which subjects were asked to recall) was to instruct three persons to read the passage and then, with the passage in front of them, have them write down all the concepts and facts that they felt were crucial for understanding the passage's meaning. The three

written protocols were scored to obtain those points which at least two readers thought were important. Of the thirty sentences chosen for the research, twenty were items on which all three agreed. The other ten were selected from the remaining pool, and were items on which two of the readers agreed. Each of the resulting sentences was printed on a single 3 x 5 inch card, thus producing the deck which was used in the sorting task. Five copies of this deck were made. Table 1 contains the sentences printed on the cards.

Procedure. The procedure used in these studies was similar to the one reported by Mandler (1967). Each subject was instructed to sort the deck of cards into either two or six meaningfully related piles. He was free to place the cards within the assigned number of piles using any system he wished, with the exception of sorting on the basis of physical features such as the first word or the number of words in a sentence. Subjects were not allowed to move a card once placed, nor to shuffle through cards already sorted. After each sorting trial subjects were given another deck of cards containing the same sentences but in a different random order, and were asked to sort them again. They were instructed that these sorting trials would continue until they reached some specified criterion of sorting consistency. Subjects were informed that they would be asked to write down the sentences after reaching criterion and that they would have to spend at least 15 minutes in the recall situation.

Subjects. The subjects were introductory psychology students at Cornell University who were fulfilling a course requirement. All were paid for their participation.

Experiment I

Method

Twenty-two subjects were instructed first to read the History passage. Upon completion, half the subjects (Group M-2) were told to place the related History cards into two piles, using Mandler's sorting task. The remaining subjects (Group M-6) were instructed to sort into six piles.

The procedure for the sorting task was similar to the one previously outlined. Each subject was run individually and was required to reach a criterion of placing all but two of the cards in the same piles on two successive sorts. They were told that they would be paid for their performance and that the amount was primarily a function of the number of statements contained on the cards that they recalled correctly. Bonus money was given to subjects who sorted to criterion in 9 minutes or less. Sorting for recall rather than speed was stressed by instructing subjects that regardless of their

TABLE 1

Sentences Used in Experiments I and II

1. Mary's weaknesses were Catholicism and loyalty to Spain.
2. Mary's mother married Henry VIII.
3. The word that sums up Mary's reign is irony.
4. Mary's religious intolerance had grave consequences.
5. Mary was England's first undisputed woman ruler.
6. Mary was proud of her Spanish ancestry.
7. Mary wanted to return England to Catholicism.
8. Englishmen feared that Mary's marriage would reduce England to a Spanish colony.
9. Mary coerced her council with strong will and temper.
10. Gardiner became England's chief minister and chancellor.
11. Gardiner kept Mary from taking measures that would bring rebellion.
12. Mary was married to Philip II by proxy.
13. In 1554, Wyatt led a full scale revolt which failed.
14. Mary wished to have a child so Elizabeth wouldn't gain the throne.
15. Mary ejected clergymen for marrying and not being Catholic.
16. Mary forced the powerful Protestants to flee England.
17. Pole was made the Pope's legate.
18. Pole was charged to return England to Catholicism.
19. Parliament repealed anti-papal legislation in 1554.
20. Mary and Pole felt that a show of force would kill Protestantism.

TABLE I--Continued

21. Pole and Mary ordered 300 common people to be burned.

22. England used the law to dispose of men who were a threat to the throne.

23. Englishmen detested the burnings because commoners were no threat to the throne.

24. The English equated Mary's cruelty with Spain and Catholicism.

25. With Gardiner's death, a restraining influence on Mary was removed.

26. Philip left Mary to take his Spanish inheritance.

27. At the urging of Philip, Mary declared war on France.

28. England's loss of Calais was a blow to English pride.

29. Mary and Pole both died within hours of each other.

30. With Mary's death, all hopes for the return of Catholicism vanished.

sorting speed to criterion, if they did not recall any statements they would not receive any money.

Results and Discussion

The sentences contained in the recall protocols for each subject were scored using a lenient scoring system. A sentence was scored as being correct if the subject recalled most of the sentence correctly but put the wrong noun (either a person or place) into the sentence, or when he did not recall the sentence verbatim but had grasped the meaning of the sentence as judged by the experimenter.

The mean number of sentences recalled and sorting time for each group are shown in Table 2. The groups did not differ in the number of sentences they could recall (t (20 df) = .32 $p > .20$). Sorting times were significantly different, with the six pile group taking more time (t (20 df) = 3.85 $p < .01$).

It is of interest that although the six pile sorting condition took more time to reach sorting criterion, hence had more time to learn the items, it did not differ from the two pile group on the number of statements recalled. The increase in sorting time as a function of more piles has been reported before in word-sorting studies (McConkie and Dunn, 1971; Dunn and McConkie, 1971). These studies, however, unlike the present, did find a relation between NC and R, even when the effect of time was statistically controlled. This suggests the possibility that when meaningfully related sentences are used as stimulus material, recall is not a function of the number of categories used to organize the material. Before this can be safely concluded, other possibilities must be explored.

TABLE 2

Mean Group Recall and Sorting Time--Experiment I

	Groups		
	M-2	M-6	Absolute Difference
Mean recall	17.1	17.7	.6
Mean sorting time (minutes)	10.1	17.4	7.4*

* $p < .01$

A plausible explanation for why no difference in recall was found is that subjects in both groups may have obtained retrieval cues while reading the passage, which were not only different but were more efficient in terms of recall than the categorical cues the subjects developed while sorting. Since both groups read the passage, both would have had an equal opportunity to develop the more efficient cues. If this hypothesis is correct, it could account for the lack of support for the category-recall relationship in the data.

Experiment II

Experiment II was conducted to investigate the possibility that subjects in the first experiment recalled primarily on the basis of retrieval cues learned while reading the passage, rather than those formed while sorting, and that this could account for the failure of NC to have an influence on recall.

Method

The effects of reading on recall were negated by having subjects read the Botany article prior to sorting the History cards. It was assumed that the cues picked up from reading the Botany passage would be of little use to subjects in organizing and recalling these cards. This task was more similar to the task Mandler used with word lists because the subjects in both studies were not required to learn material related to the cards prior to organizing them.

After reading the irrelevant Botany article, seven subjects (Group C-2) were asked to place the cards into two meaningful piles; eight others (Group C-6) were instructed to sort into six piles.

The basic procedure was similar to the one used in Experiment I with the exceptions that subjects were run in groups of five with each subject starting the experiment at a different time, and each subject receiving four sorting trials. Subjects were informed that they would be paid for their recall, and that the more they recalled the more they would make. Unlike the first experiment, no bonus was given because subjects in the present experiment were not required to reach a sorting criterion. The importance of forming a good meaningful organization was stressed to subjects, and they were asked to try to place the cards into exactly the same piles on trials three and four. After sorting the fourth deck, subjects were asked to recall as many of the points from the cards (not the chapter) as they could in any order they wished.

Results and Discussion

Items contained in the recall protocols for each subject were scored using two scoring systems, strict and lenient. An item was scored as being correct under the lenient system if it met the criteria of the lenient scoring system used in Experiment I. For a main point to be correct using the strict system, the subject not only had to remember the right nouns but had to remember the sentence almost word for word. If an item was not contained on one of the cards, it was considered to be an error.

Table 3 shows the mean number of sentences recalled and sorting time for the two groups. Analysis of the recall data showed no differences between the sorting groups using either the strict or lenient scoring systems (Lenient--t (13 df) = .33 $p > .20$; Strict--t (13 df) = .21 $p > .20$). Differences in sorting time were found, with group C-6 taking significantly more time to sort the cards for the four trials (t (13 df) = 2.35 $p < .05$).

These results, like those in Experiment I, again indicate that there is no advantage in utilizing more categories when meaningfully related material is organized, even when more time is expended in sorting.

These results also argue against the tentative hypothesis that the subjects in Experiment I did not exhibit category-recall function because they learned a retrieval system while reading the related History passage and used it during recall. If this had been the case, group C-6 would have recalled more main points than group C-2 since both read an irrelevant passage and thus had no opportunity to learn such a system.

TABLE 3

Mean Group Recall and Sorting Time--Experiment II

	Groups		
	C-2	C-6	Absolute Difference
Mean recall			
Lenient	20.0	20.8	.8
Strict	19.7	19.2	.5
Mean sorting time (minutes)	12.2	19.0	6.8*

*$p < .05$

The negative results of Experiment II suggest another possible explanation. Perhaps the subjects in both experiments were picking up the relationships which were inherent in the passage from the cards alone, since they stated the main points in the passage, and were using these relationships as retrieval schemes rather than the categories they formed by sorting. This argument has some plausibility because subjects were forced to sort the cards into a specific number of piles. If the relationships contained in the cards were not easily placed into the assigned number of piles, then recall would not necessarily be related to the number of piles used in sorting.

Perhaps the category-recall function is only found when using material that has less internal structure than the cards used in the first two experiments. If this were true, it follows that if the internal relationships were altered so as to destroy the theme (the cards dealt specifically with Mary Tudor's life), then subjects may be more prone to use categories developed in sorting as retrieval cues.

Experiment III

Experiment III was designed to investigate whether the Mandler effect is obtained when sentences with fewer internal relationships are used. Of the present series of studies, this experiment is the most similar to the previous research which investigated the relation between NC and R. Like the past research which used word lists, this experiment used stimulus materials that had little thematic structure.

Method

New decks of cards were developed from the History cards used in Experiments I and II. The new decks contained sentences which retained the syntactical structure of the cards used in the two previous experiments, but differed from the originals in their inherent internal relationships. It was assumed that the internal relations among the original cards could be weakened by changing the names of some of the characters and countries of the sentences presented on the cards. As can be seen from Table 4 in the modified statements, the most frequent name in the original set of cards, Mary Tudor, was replaced by four other names in different sentences: Catherine, Ann, Mary and Elizabeth. The 20 original sentences that contained Mary's name were changed by inserting one of the four names in approximately equal proportions. Original sentences containing names of countries and secondary characters were changed in a similar manner.

TABLE 4

Sentences Used in Experiment III

1. Catherine's weaknesses were Protestantism and loyalty to Russia.
2. Ann's mother married George III.
3. The word that sums up George's reign is irony.
4. Mary's political intolerance had grave consequences.
5. Catherine was Russia's first undisputed woman ruler.
6. Elizabeth was proud of her Spanish ancestry.
7. Mary wanted to return England to Catholicism.
8. Legislators feared that Catherine's marriage would reduce Europe to a Russian colony.
9. More coerced his council with strong will and temper.
10. Garrett became Austria's chief minister and chancellor.
11. Garrett kept Ann from taking measures that would bring rebellion.
12. Ann was married to Henry II by proxy.
13. In 1594 Wyatt led a full scale revolt which failed.
14. Mary wished to have a child so Elizabeth wouldn't gain the throne.
15. Catherine ejected politicians for bribery and not being Methodist.
16. Ann forced the powerful socialists to flee England.
17. More was made the Pope's legate.
18. More was charged to return England to Catholicism.
19. Parliament repealed anti-papal legislation in 1554.
20. Mary and George felt that a show of force would kill Protestantism.

TABLE 4--Continued

21. Mary and George ordered 300 common people to be burned.

22. England used the law to dispose of men who were a threat to the throne.

23. Frenchmen detested the burnings because Protestants were no threat to the throne.

24. The Austrians equated Elizabeth's cruelty with Spain and despotism.

25. With Garrett's death a restraining influence on Ann was removed.

26. Henry left Elizabeth to take his Spanish inheritance.

27. At the urging of Garrett, Ann declared war on France.

28. France's loss of Kuwait was a blow to France's pride.

29. Catherine and More both died within hours of each other.

30. With Elizabeth's death, all hopes for the return of the monarchy vanished.

The design and procedure of this experiment was identical to Experiment II. Twenty-eight Cornell undergraduates read the irrelevant Botany passage, and then half (group P-2) sorted into two piles and the other half (group P-6) sorted into six piles. After sorting for four trials, subjects recalled the sentences on the cards.

Results and Discussion

Recall data were scored using the strict and lenient scoring system described in Experiment II. Table 5 shows mean recall and sorting time for each group. A one-tailed test on the lenient scores found that group P-6 recalled significantly more sentences than group P-2 (t (26 df) = 1.78 $p < .05$). Analysis of the strict scores did not reach significance at the same level (t (26 df) = 1.48, $p < .10$). Sorting times were again found to be significantly different, with P-6 again taking more time to sort (t (26 df) = 1.81, $p < .05$ one-tailed).

TABLE 5

Mean Group Recall and Sorting Time--Experiment III

	Groups		
	P-2	P-6	Absolute Difference
Mean recall			
Lenient	14.6	18.6	4.0*
Strict	11.7	15.3	3.6
Mean sorting time (minutes)	17.0	23.9	6.9*

*$p < .05$ one-tailed

These results suggest that when sentences have little thematic organization, the number of categories used in sorting does tend to be related to increases in recall. However, because the sorting time analysis showed that the six pile group took more time in sorting, it could be argued that the increase in recall was a function of increased learning time rather than use of more categories. A partial correlation between NC and R, based on the lenient scores and holding time constant, was found to be insignificant ($r = .25$; t (25 df) = 1.31 $p > .10$). This indicates that the increased recall

for group P-6 may have been mainly a function of time rather than of categories. This result is contrary to previous research which has used word lists as stimulus material (Mandler, 1967, 1968b; Mandler and Pearlstone, 1966; McConkie and Dunn, 1971; Dunn and McConkie, 1971). In all these cases the relation between NC and R was obtained when time was statistically controlled. However, because of the small number of subjects used, this study should only be accepted as being suggestive.

General Discussion

The data from the first two experiments do not support the previous research which had shown a direct linear relation between the number of categories used in sorting and number of items that can then be recalled. Experiment II showed that the negative results of Experiment I were not due to a superior retrieval system subjects might have learned while reading a passage related to the cards they were asked to sort.

The recall analysis of Experiment III seems at first glance to show that the Mandler effect can be obtained with prose materials when the thematic organization is destroyed. However, when sorting time differences were statistically controlled, the relation between NC and R was reduced to a level not statistically significant. These results are clearly at odds with the prior research, and suggest that the relation between NC and R may only occur when word lists are used as stimulus material. If the relation does occur with sentences, it is weak and is present only when there is very little pattern of relationships among the sentences.

These pilot studies suggested that the Mandler effect might be found with prose only under very limited conditions, if at all. The main experiment, to be reported next, was carried out to provide a much broader test of whether the Mandler effect is found with prose, as well as whether recall and use of information from prose is facilitated by certain techniques found in the Structural Communication curriculum method. This study overcame many of the objections to the pilot studies. Three different study units were used, boys and girls participated in equal numbers, and the subjects were all high school students, thus providing a more normal sample than the Cornell University students used in the pilot work.

CHAPTER III

MAIN EXPERIMENT--METHOD

Subjects

One hundred ninety-two male and female high school students, including sophomore, juniors and seniors, from two Central New York State high schools served as subjects. All subjects volunteered and all but 40 were paid for their participation.* The 40 non-paid subjects were evenly distributed across experimental conditions.

Materials

Three study units were used as the basis for the stimulus material in this experiment. Two of these were provided by the Centre for Structural Communication, and the third was designed especially for this research. The topics of the Structural Communication units were English History and Historical Economics, with the former dealing with the life and reign of Mary Tudor, and the latter dealing with the early English cloth trade. The third unit was based on a short passage taken from Coulter and Dittmer's (1964) introductory botany text and dealt with blue-green algae. This unit was designed to be highly similar to those provided by the Centre.

The Presentation section of each of the study units was made into a booklet by dividing each section into parts of approximately 160 words and printing each part on a separate page. Each booklet contained about 17 pages. Two booklets (History and Botany) were the same as those used in the pilot experiments. The contents of each of the booklets are reproduced in Appendix B.

As explained in Chapter II, previous research (Amato, 1970) has indicated that the complexity of the statements presented in the Response Indicators of the Structural Communication study units make them difficult for subjects to recall. Therefore, less complex

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*The principal at one high school thought that remuneration of students for their participation would be a poor precedent to set.

statements of main points in each passage were obtained in the same method as was previously outlined in Chapter II. For each passage the 30 main points selected were written into sentences of no more than 78 characters and each was printed on a separate computer card. This resulted in three decks of 30 cards each, one for each passage. Thirty copies of each of the topic decks were then produced, which were the decks actually used for sorting. Table 1 (Chapter II) contains the statements selected for the History passage, and Tables 6 and 7 contain the statements for the Botany and Economics passages.

TABLE 6

Botany Sentences Used in Main Experiment

1. Blue-green algae are the simplest living organisms.
2. Gloeocapsa is unicellular and is the simplest blue-green algae.
3. Protoplasm is the essential living substance.
4. Wall around cell protects protoplasm and maintains shape of the cell.
5. Protoplasm of plant cells is enclosed by walls of cellulose.
6. "Cell-principal"--plant and animal cells come from the division of other cells.
7. Most higher plants and animals have coordinated multicellular bodies.
8. The gloeocapsa is considered a primitive organism because it is unicellular.
9. Phycocyanin and chlorophyll cause gloeocapsa to be bluish green in color.
10. Chlorophyll is present in all green plants.
11. Chlorophyll enables the plant to manufacture food out of non-food substances.
12. A chlorotic plant's green color can be restored by supplying it with iron.

TABLE 6--Continued

13. Green plants are independent and can live by themselves without other life forms.

14. Independence is a second reason for regarding gloeocapsa as primitive.

15. Gloeocapsa lives at the bottom of shallow pools of fresh water.

16. Gloeocapsa uses most of its manufactured food to keep its protoplasm alive.

17. Gloeocapsa does not have specialized tissues to store food.

18. Growth in organisms is part expansion of cell size and part cell repair.

19. Simple protoplasm is the third reason for regarding gloeocapsa as simple.

20. Simple reproduction is the fourth reason for regarding gloeocapsa as primitive.

21. Reproduction by fission occurs when a cell splits to form two daughter cells.

22. Gloeocapsa does not have any special reproductive organs.

23. Reproduction of gloeocapsa is by vegetative multiplication.

24. Sometimes daughter cells remain stuck together by parent's mucilaginous sheath.

25. Colonies are formed when independent cells are stuck together.

26. In nature, many blue-green algae are often stuck together in slimy masses.

27. Some blue-green algae grow in salt water and contain a red pigment.

28. Some blue-green algae can live under extreme changes of temperature.

29. Bacteria are the closest relatives of blue-green algae.

30. Bacteria lack chlorophyll and cannot make their own food.

TABLE 7

Economics Sentences Used in Main Experiment

1. Wool was England's main export during the Middle Ages.

2. English wool was the best in Europe.

3. England's cloth industry started to develop 150 years before Henry VII's reign.

4. Growth of the cloth trade during the early 16th century was spectacular.

5. A large proportion of the population was dependent on the cloth industry.

6. Profits were good for the merchant adventurers.

7. England's prosperity was precarious because it was based only on sale of cloth.

8. Europe's price rise and Henry VIII's debasement of currency hurt the cloth industry.

9. The merchant adventurers controlled the cloth trade.

10. The merchant adventurers prevented non-company merchants from gaining profit.

11. Independent merchants had little chance of survival against the organizations.

12. Merchant adventurers usually did not pool their resources.

13. During Henry VII's reign, merchant adventurers enjoyed a low tax on cloth.

14. England experienced a gradual price rise during the first part of the 16th century.

15. One of the main causes of rising prices was the influx of Spanish silver.

16. English merchants made better than average profits selling to Spain.

TABLE 7--Continued

17. English prices began to rise more rapidly because of cloth industry's wealth.

18. Henry VIII's economic policies were short sighted and disastrous.

19. Henry VIII devalued the pound.

20. Because coins were worthless, more had to be given to obtain the same goods.

21. Because of their low selling price, English merchants could sell much cloth.

22. In 1551, because of social unrest, the English government reformed the value of coins.

23. The reformed money policies made it difficult to sell cloth abroad.

24. The merchants, having too much cloth, were desperate to find new outlets.

25. A spate of new voyages along new routes was a result of the economic crisis.

26. After 1551, adventurers lobbied for protection against coinage reform.

27. The protection given to the adventurers by the English government cost dearly in taxes.

28. Joint-stock companies contained investors who risked money in expeditions.

29. The step from respectable trader to pirate was not great in these times.

30. Because there was no set of laws all countries agreed on, the cannon ruled.

Three different types of cardboard sorting boxes were constructed. Each contained bins the size of a computer card, thereby allowing only the top card contained in that bin to be seen. The boxes differed in the number of bins (one, two or six) each contained.

Three challenges and one essay question were prepared for each of the passages. For the passages from Structural Communication study units, paraphrased versions of three challenges contained in the units themselves were used. Similar challenges were prepared for the Botany passage. Essay questions were obtained from the Structural Communication units by selecting and modifying the most general challenge contained in each unit. Again, a similar question was prepared for the Botany passage. These challenges and essay questions are found in Appendix C.

Design and Procedure

Eight experimental conditions, requiring eight groups of 24 students each, were used. Within each of the groups, four male and four female students were tested with each of the three different study units used in the experiment. This yielded a 2 (sex) by 3 (subject matter) by 8 (experimental condition) factorial design, with subjects randomly assigned to condition.

All subjects read one of the Presentation sections contained in one of the booklets prior to the experimental task they were given. Immediately after they finished reading, they were given written instructions which explained the experimental task that they would subsequently perform. All subjects except those in group R-2 were then given a sorting box and three decks of cards, with each deck containing the same 30 sentences arranged in different random orders. These groups were each given three sorting trials in which they were asked to place the cards in one, two or six piles, depending on the experimental condition. After each subject finished a sorting trial, his cards were picked up and special dividers were inserted between sets of cards placed in different piles. These decks were later read into a computer, which kept a complete record of the piles into which each subject sorted the sentences, and the time he spent in sorting the cards.

All groups, with the exception of group R-2, were informed that after completing their task they would have to write down as many of the sentences contained on the sorting cards as they could remember. Subjects in group R-2, since they did not participate in the sorting task, were instructed that they would be asked to write down as many of the main points of the passage they read as they thought were important. Following sorting, subjects were allowed 15 minutes for a

written recall. All subjects were then given an appropriate essay question for which they were asked to write an answer, and were allowed an additional 15 minutes for the completion of this part of the experiment. The recall protocols were scored by both strict and lenient criteria, as will be described in the next chapter. A complete listing of the sentences each subject recalled, and the order of their recall, was also stored in the computer. A description of the scoring system for the essay questions will also be postponed to the next chapter.

The conditions under which each of the eight experimental groups learned and were tested will now be described. Four of the groups were most similar to the conditions used by Mandler (1968) and to the conditions used in the pilot experiments reported in Chapter II. Groups C-2 and M-2 each sorted the cards of each deck into two piles; groups C-6 and M-6 each sorted into six piles. The C and M groups differed with respect to the passages they read prior to sorting the sentences. Subjects in groups M-2 and M-6 each read a passage for which the sentences they later sorted were summaries of the main points. Subjects in groups C-2 and C-6 each read some other passage unrelated to the cards they later sorted. Although the subjects in these conditions were told how many piles to use, they were free to place the sentences within the designated number of piles using any system they wished, with the exception that they were discouraged from sorting on the basis of such physical features as the number of words in a sentence. They were told that on the second sorting trial they could make any necessary changes in the organization which they had formed on their first trial, so that during the third sort they would then be able to place the cards into exactly the same piles as they had on the second sorting trial. On the recall test they recalled as many sentences from the sorting task as possible. The complete instructions for each experimental group can be found in Appendix D.

Subjects in groups SM and S were given a task more similar to that used in the Structural Communication study units, in which they were asked to sort the sentences in accordance with challenges. These subjects all read the passage related to the sentences which they later received. Those in group SM were given a different challenge prior to each sorting trial and asked to sort the cards into two piles on the basis of that particular challenge. All cards which related to the challenge or answered the question posed by it were to be placed in the left pile, and those which were not related were to be placed in the right pile. Thus, on each trial the students sorted the cards in a different way, according to the challenge given them on that particular trial, although always sorting into two piles. Subjects in group S, on the other hand, were given a single challenge for all three sorting trials. The challenges were the same as those given to group SM but, since each subject received

only one challenge, different subjects were given different challenges, thus all challenges were used about an equal number of times. The task given to group SM was that most similar to the Structural Communication procedure. Group S was somewhat similar in that they sorted according to a challenge, but was also similar to the task Mandler used in that they had a single criterion for sorting on all three sorting trials, allowing them to reach a more stable organization.

Two further groups were included for comparison purposes. Subjects in group R, after reading a passage, were given the set of sentences related to that passage and instructed to read them carefully as they placed the cards, one at a time, into a single pile. Thus, they simply read through the sentences three times with the purpose of preparing for a recall test. Subjects in group R-2 did not participate in a sorting task. After reading the passage, they were simply instructed to read the passage again to prepare for a test in which they would be asked to write down as many of the main points from the passage as they could remember. Reading the passage the second time took about the same amount of time as that required for three sorting trials.

CHAPTER IV

MAIN EXPERIMENT--RESULTS

This chapter is divided into two main sections. The results of the recall and sorting time data are considered first, followed by a section dealing with the essay data. In each of the sections, the method of scoring will first be outlined, followed by the general results of analyses of the data. Next, the results of a priori comparisons related to specific questions the research was designed to answer will be presented. A limited discussion of the results will be presented in connection with these a priori questions. A more detailed discussion will be reserved for Chapter V.

Recall and Sorting Time Data

Treatment of data. The subjects' recall protocols were scored using the strict and lenient scoring systems outlined in Chapter II. An item was scored as correct under the lenient system if a subject either wrote down the general meaning of the experimental sentence (as opposed to the exact structure), or recalled the sentence primarily intact but placed a wrong noun into the sentence frame. For an item to be scored as correct using the strict scoring system, a subject had to (with the exception of a few difficult sentences) recall the sentence almost verbatim. For example, nouns, adjectives, adverbs and most conjunctions were required to be correctly recalled, whereas mistakes in articles were usually ignored in scoring.

Because of the complexity of the scoring systems and severe time limitations caused by having to record each subject's data so that his sorting cards could be used for other subjects the next day, the following analyses are based entirely on the experimenter's scoring of the data. Since this could lead to systematic biasing of the data, reliability measures were computed between the scoring by the experimenter and by an independent judge. A random stratified sample of 48 recall protocols was chosen from the total population of 192 recall protocols. Six recall sheets from each of the eight conditions were selected, with two of the sheets representing each of the three subject matters (History, Botany and Economics) used in that condition. One of the two sheets chosen was produced by a male, the other by a female.

In scoring, the experimenter (from this point referred to as Rater A) judged whether or not each item on a given recall sheet was one of the items contained on one of the cards in the sorting deck. If it was, he recorded the number of the recalled sentence, as well as indicating whether it was judged as correct under strict criterion, or only under the lenient criterion. If the recalled sentence did not correspond closely enough to one of the presented sentences, it was scored as an error. At a later time Rater B also scored the 48 recall sheets of the sample in an identical manner. The scoring made by Rater A was covered to prevent a biasing of Rater B's scoring.

Table 8 contains data on the frequency of agreement between the two raters on their scoring of the 48 recall sheets. These sheets contained a total of 640 recalled items. The judges agreed on finding 603 acceptable for at least the lenient criterion, and 39 unacceptable. They disagreed on 37 of the items, or a total of 5.8% of the total sample. A reliability coefficient described by Scott (1955), developed specifically to determine the reliability of nominal data, yielded a correlation of .92. Of those items which the raters agreed were accurate, there were seven on which they disagreed as to which sentence was being recalled. These items were excluded from the above analysis.

TABLE 8

Frequency of Agreement of Raters' Scoring
Of the Sample Recall Protocols--
Main Experiment

		Rater B			
		Strict	Lenient Only	Error	Total
Rater A	Strict	383 (1)*	106 (4)	7	496
	Lenient Only	7 (1)	68 (1)	20	95
	Error	1	9	39	49
	Total	391	183	66	640

*Numbers in parentheses indicate the number of times the two raters both scored an item as correct, but disagreed as to which sentence was being recalled. Note that those items are not included in the marginal totals.

The primary difference between the two raters was in their criteria for judging items as being correct by the strict or lenient scoring rules. As can be seen from the marginal totals in Table 8, Rater B tended to be more stringent in her scoring, assigning many more of the correct items to the "lenient only" category.

These data indicate that the scoring of correctness was acceptably reliable, but that there was substantial unreliability in determining whether a correct item should be counted as being correct under the strict scoring system; that is, the lenient scoring system was more reliable than the strict scoring system.

General results. Table 9 gives the results of a 3-way analysis of variance computed on the lenient recall data. The analysis showed that all main effects (sex, groups and materials) were significant. The only interaction that reached significance was the Sex by Materials interaction, which is shown in Figure 2. From this figure it is apparent that males obtained lower recall scores than females with the Botany materials, and that this accounts for the interaction.

TABLE 9

Results of the Analysis of Variance on the Leniently-Scored Recall Data--Main Experiment

Source	df	F	Probability Level
Main effects			
Sex	1, 141	8.893	.003*
Groups	7, 141	7.402	.001**
Materials	2, 141	17.259	.001**
2-way interactions			
SG	7, 141	1.102	.365
SM	2, 141	5.168	.007*
GM	14, 141	.999	.458
3-way interaction			
SGM	14, 141	.906	.554

*Significant at the .01 level
**Significant at the .001 level

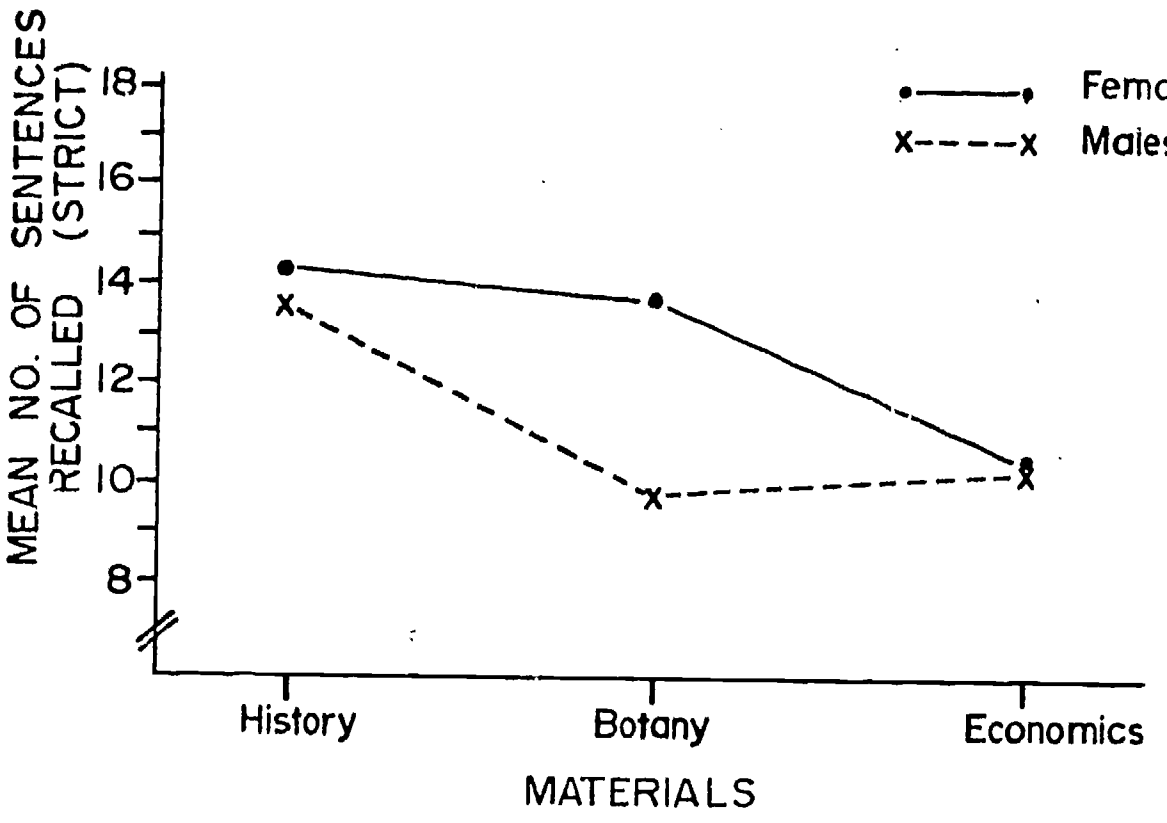

Fig. 2. Mean strict recall as a function of sorting material and sex—Main Experiment

A similar analysis of variance performed on the strict data is shown in Table 10. Basically, the same pattern of results was obtained, but this time the main effect for sex did not quite reach the .05 significance level. Again, the only interaction that reached significance was the Sex by Materials interaction.

TABLE 10

Results of the Analysis of Variance on the Strictly-Scored Recall Data--Main Experiment

Source	df	F	Probability Level
Main effects			
Sex	1, 141	3.843	.052
Groups	7, 141	7.466	.001**
Materials	2, 141	16.215	.001**
2-way interactions			
SG	7, 141	1.015	.423
SM	2, 141	4.227	.016*
GM	14, 141	.925	.534
3-way interactions			
SGM	14, 141	.881	.581

*Significant at the .05 level
**Significant at the .001 level

Table 11 shows the means for males and females for both the leniently- and strictly-scored data. Clearly, females tended to recall more sentences than males. In light of the significant Sex by Materials interaction, however, this increased recall seems primarily due to the fact that females recalled more Botany points than males.

TABLE 11

Mean Number of Sentences Recalled
As a Function of Sex--
Main Experiment

Scoring System	Sex	
	Male	Female
Strict	9.3	10.4
Lenient	11.2	12.8

Tables 12 and 13 report the mean recall scores under the lenient scoring system for different materials and different experimental groups, respectively. They also present the results of Newman-Keuls tests for significant differences among these means (Winer, 1962). The pattern of results obtained under the strict scoring system was almost identical, and will not be reported.

TABLE 12

Mean Number of Sentences Recalled (Leniently-Scored)
As a Function of Subject Matter

Subject Matter		
Economics	Botany	History
10.3	11.7	14.0

Means with a common underline are not significant at the .05 level when tested by the Newman-Keuls Test (Winer, 1962).

As can be seen from Table 12, mean recall of the History sentences was significantly greater than that of the other two subject matters, which accounts for the significant materials effect.

TABLE 13

Mean Number of Sentences Recalled (Leniently-Scored)
In Each of the Experimental Conditions--
Main Experiment

Experimental Condition							
R-2	C-2	S	SM	C-6	M-2	M-6	R
7.9	10.1	11.8	12.2	12.4	13.0	13.7	14.5

Means with a common underline are not significant at the .05 level when tested by the Newman-Keuls Test (Winer, 1962).

An examination of Table 13 shows that group R-2 recalled significantly fewer main points than all the other groups. This is not surprising since this group merely read the passage twice and wrote down what they thought were main points, whereas the other groups were given statements of the main points to learn. Also, group C-2, which read a passage unrelated to the cards sorted, recalled significantly fewer sentences than did several other groups, specifically M-2, M-6 and R. Interestingly enough, this was not the case for group C-6, the other group which read an irrelevant passage. Beyond these, there were no other significant differences among the groups.

Table 14 shows the results of a similar 3-way analysis of variance of the sorting time data (for group R-2, the time required for the second reading of the passage was used instead). None of the main effects or interactions proved to be significant. The means and standard deviations for each cell of the recall and sorting time analyses can be found in Appendix E.

TABLE 14

Results of the Analysis of Variance
Of the Sorting Time Data--
Main Experiment

Source	df	F	Probability Level
Main effects			
Sex	1, 141	3.589	.060
Groups	7, 141	1.808	.090
Materials	2, 141	1.954	.145
2-way interactions			
SG	7, 141	1.079	.380
SM	2, 141	2.393	.095
GM	14, 141	0.740	.731
3-way interaction			
SGM	14, 141	0.614	.850

A priori comparisons. As was stated in the introduction to this chapter, specific planned comparisons between selected experimental conditions were made in order to answer several important questions deemed necessary to fulfill the goals of this research.

In the following reported analyses the lenient recall data were used almost exclusively. There were two major reasons for this: first, the leniently-scored data were shown to be more reliable; and, second, data from strict scoring yielded almost identical patterns of results as that from lenient scoring. Mention will be made where the two scoring systems did not yield the same results.

The first two a priori comparisons answered specific questions concerning the Structural Communication technique. The questions and the resulting comparisons are as follows:

1. Does having a challenge by which to organize the main points of a passage produce a different amount of recall than does self-imposed organization? Means from conditions M-2 (13.042) and S (11.833) were compared to answer this question because both read a passage related to the main points they organized during sorting. Further, both sorted into two piles on each trial; thus, each was required to form a stable sorting pattern. No significant difference

in recall was obtained (F (1,181 df) = 1.09, $p > .25$). Thus, it appears that having a challenge by which to organize the main points of a passage (group S) does not provide for better recall than allowing a person to organize the material using his own system (group M-2); in fact, what difference there was in this study favored group M-2.

2. Does reviewing the concepts and facts from three different frames of reference (that is, using three different challenges) produce a different amount of recall than several trials using a single challenge? The mean recall of the Structural Communication group SM, which received a different challenge for each of its three trials, and group S, which sorted to the same challenge for its three sorts, were compared. The small mean difference (12.0 for group SM; 11.8 for group S) was insignificant (F (1,181 df) = .10, $p > .50$). These results show no advantage to recall from using three different focal points by which to organize the main concepts of a study unit.

The following question concerns a matter of control:

3. Does the task of sorting into piles result in greater recall of concept sentences than merely reading them with instructions to learn them? This question was answered by comparing the mean of group R, which was instructed to read rather than organize the cards, with the means of groups M-2, M-6, S and SM. Each of these latter groups, as you will recall, was given instructions to organize the cards in some manner other than merely reading each of them. The results of the conservative Dunnett multicomparison test (Winer, 1962) found no significant difference in recall between group R and the other groups. When a less conservative test was used (Bruning and Kintz (1968), only group S was found to differ from group R (t (181 df) = $p < .05$). Thus, it would appear that simply reading the cards produces at least as much recall as organizing them through sorting trials, and perhaps better recall than organizing to a single challenge (group S). Note that it is not assumed that the subjects in group R did not subjectively organize the cards while reading them. They may, in fact, have organized the sentences as Tulving's (1962, 1966) subjects did with lists of words. Unfortunately, there were too few subjects who received each of the subject matters (8 subjects each) to compute meaningful subjective organization measures for the present data. The important point is that group R was not given <u>specific</u> organizing tasks as were the other groups.

One of the major goals of the present research was to ascertain whether the effect of the number of categories (NC) on recall (R) found by Mandler, using word lists, is obtained when prose is used

as stimulus material. In order to assess the role of NC on the recall of prose, a series of pertinent a priori questions was asked and resultant comparisons made on the recall data. These questions are as follows:

4 a. Is the recall of complex material (the thematically related experimental sentences) influenced by the number of piles used in sorting?

4 b. Does reading a passage related to the main points one is asked to organize in a Mandler sorting-task produce higher total recall than reading an unrelated passage prior to sorting these same cards?

4 c. If the relationship between NC and R is obtained with these materials, is the relationship affected by whether or not a student has read a related passage?

In order to answer these questions, the recall and sorting time data from four of the groups contained in the main experiment, groups C-2, C-6, M-2 and M-6, were re-analyzed using a 4-way analysis of variance. These four groups were the most similar to those used by Mandler. The independent variables incorporated in this analysis were sex, materials, reading (reading a related vs. reading a non-related passage), and number of piles used in sorting. Table 15 shows the results of the 4-way analysis of variance performed on the lenient recall data for these groups. Both the main effects of reading condition and materials were highly significant. The main effect of number of piles did not reach significance, although it was extremely close ($F(1,72) = 3.79$; $p < .055$). Only the Sex by Piles interaction reached significance and is shown in Figure 3. This interaction shows that females' recall scores increase as a function of the number of piles used in sorting, whereas males' recall is not affected.

TABLE 15

Results of a 4-Way Analysis of Variance
Of the Leniently-Scored Recall Data
From Groups C-2, C-6, M-2 and M-6
--Main Experiment

Source	df	F	Probability vel
Main effects			
Sex	1, 72	3.584	.062
Reading	1, 72	7.609	.007**
Materials	2, 72	7.958	.001***
Piles	1, 72	3.791	.055
2-way interactions			
SR	1, 72	.845	.361
SM	2, 72	2.620	.080
SP	1, 72	4.224	.043*
RM	2, 72	.371	.692
RP	1, 72	1.170	.283
MP	2, 72	1.885	.159
3-way interactions			
SRM	2, 72	.027	.973
SRP	1, 72	1.416	.238
SMP	2, 72	.514	.600
RMP	2, 72	.005	.995
4-way interaction			
SRMP	2, 72	1.387	.256

*Significant at the .05 level
**Significant at the .01 level
***Significant at the .001 level

A similar analysis run on the strictly-scored data followed basically the same pattern as the above, with a few exceptions. Unlike the previous analysis, the main effect due to piles was found to be significant ($F(1,72) = 4.28$ $p < .042$), with the six-pile condition resulting in higher mean recall than the two-pile condition

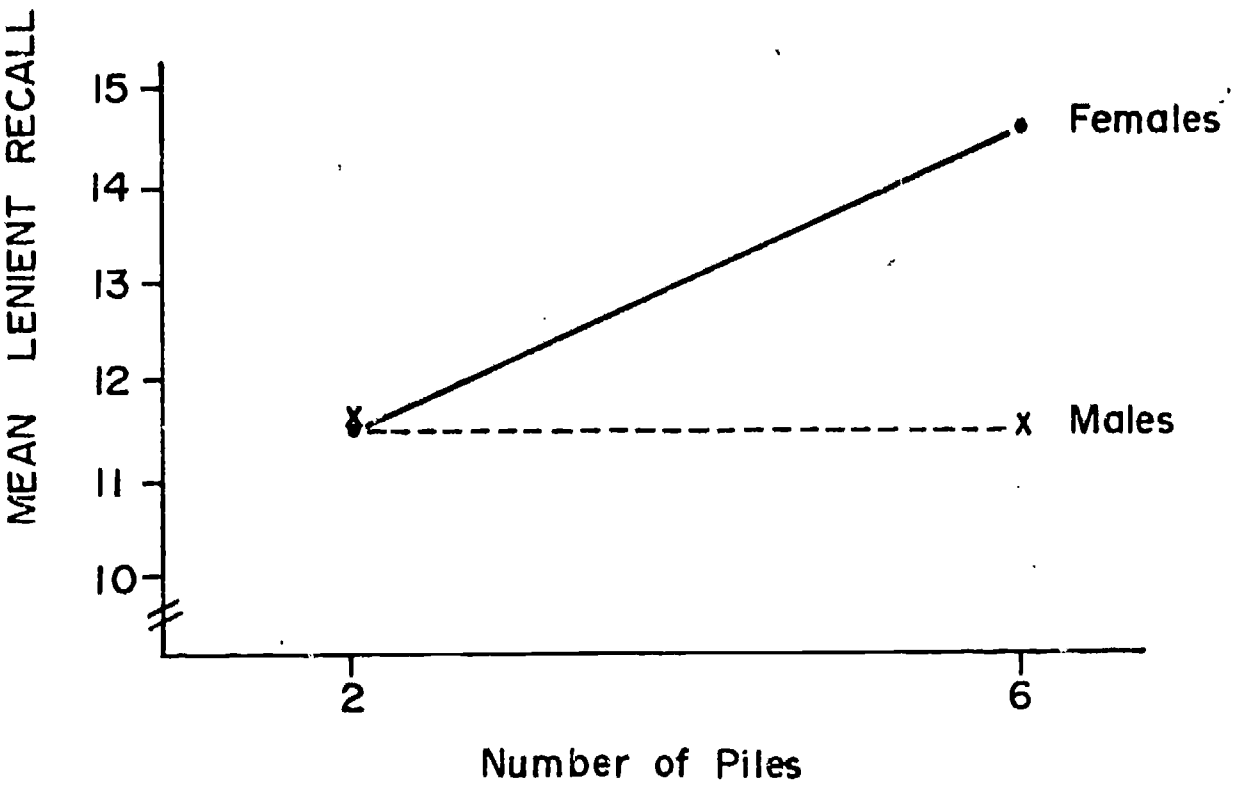

Fig. 3. Mean recall scores (lenient scoring) as a function of piles used in sorting by males and females—Groups C-2, C-6, M-2 & M-6—Main Experiment

(11.0 vs. 9.3 sentences respectively). Also, the Sex by Piles interaction failed to reach the significance level (F (1,72) = 3.122 $p < .08$). This interaction had a similar pattern to that shown in Figure 3 and hence is not illustrated here.

The results just reported indicate that females tended to recall more of the sentences after sorting into more piles; that is, they showed the same pattern of results as was found by Mandler in his word list studies, but the males did not.

A 4-way Analysis of Variance was also used to analyze the sorting time data for groups C-2, C-6, M-2 and M-6. In this analysis the only significant effect was the main effect for number of piles used in sorting (F (1,72 df) = 9.44, $p < .003$). Subjects sorting into six piles required more sorting time than those sorting into two piles (15.0 vs. 12.9 minutes, respectively). This is the same result that was found in the three pilot experiments.

The possibility was raised in the third pilot experiment that the relationship between NC and R, where it is found, using sentences as stimulus materials, might result from subjects having more learning time when sorting into more piles. Two questions may now be raised regarding the results obtained so far. First, was the difference which was found between males and females in the main experiment also present in the pilot studies? Second, if this difference appears to be reliable, can it be attributed to a tendency for females who sort into two piles and into six piles to show a greater difference in sorting time than do males who sort into two piles and into six piles? That is, does sorting into different numbers of piles have relatively little effect on sorting time for males, but much greater effect for females? If so, this difference could account for the recall performance difference found between males and females.

To answer the first question, the recall data from the three pilot studies were examined to obtain means for males and females separately. These are presented in Table 16. Although the number of subjects contributing to many of the means is small, it is true that in every case there was a greater tendency for females' recall to increase with number of piles used in sorting than for males' recall to do so. It appears that this is a reliable phenomenon, and will be referred to as the sex-limited Mandler effect.

TABLE 16

Mean Recall (Lenient) as a Function of Sex
And Number of Sorting Piles for
Pilot Experiments I, II and III

Experiment		Piles		Difference
		2	6	(6 pile-2 pile)
I	Male (n=8)	16.8	17.4	.6
	Female (n=3)	18.0	18.7	.7
II	Male (2 pile n=3) (6 pile n=4)	22.7	17.8	-4.9
	Female (n=4)	18.0	23.8	3.8
III	Male (n=10)	13.7	16.0	2.3
	Female (n=4)	17.0	25.3	8.3

To answer the second question, whether this phenomenon can be attributed to differences in sorting time, the sorting time data from the pilot studies were re-examined and mean sorting times computed for males and females separately. These means are presented in Table 17, along with the corresponding means from the Main Experiment. It is clear that the sex-limited Mandler effect cannot be attributed to differences in sorting time trends for males and females. In the main experiment, females who sorted into two and six piles were more similar in sorting time than were males, a trend just the opposite of the difference found between males and females in number of sentences recalled. Both males and females consistently show a tendency to spend more time sorting into six piles than into two.

TABLE 17

Mean Sorting Time (in Minutes) as a Function of Sex And Number of Sorting Piles for Pilot Experiments and Main Experiment

Experiment	Piles		Difference (6 pile-2 pile)
	2	6	
I Male (n=8)	8.9	16.6	7.7
Female (n=3)	13.4	20.2	6.8
II Male (2 pile n=3) (6 pile n=4)	12.1	15.1	3.0
Female (n=4)	12.3	23.0	10.7
III Male (n=10)	17.2	23.2	6.0
Female (n=4)	16.5	25.5	9.0
Main—Male (n=48)	13.2	17.2	4.0
Female (n=48)	12.7	14.5	1.8

Before answering the a priori questions concerning the Mandler effect, it is necessary to present two further analyses, both of which investigated the relation between indices of subjective organization and recall.

The first of these analyses dealt with the question of whether recall was greater when items were stably organized during sorting. It was assumed that for those groups who were asked to sort on all three trials according to a single criterion (groups S, C-2, C-6, M-2 and M-6), the sentences which were placed into identical piles on the second and third sorting trials could be considered to be stably organized. Those sentences which were placed in different piles on those two trials were assumed to still be unstable; that is, not yet adopted into the organization the subject was constructing. On this basis, two scores were computed for each subject: the proportion of stable items recalled (P(R/Stable)) and the proportion

of unstable items recalled (P(R/Unstable)). The data of subjects who did not have any items of one of these two types were excluded from the analysis.

Table 18 reports the mean conditional proportions for the stable and unstable items by materials and sorting condition. If subjective organization were important for recall, as the work of Mandler and Tulving suggests, then one would expect significantly better recall of items which were stable in the subject's cognitive organization than of items still unstable. Although the obtained difference was in this direction, a t-test for correlated means failed to find this difference significant (t (14 df) = 1.72 $p > .05$). Thus, the hypothesis that stable items would be more likely to be recalled than unstable items was not supported.

TABLE 18

Mean Conditional Proportions of Recall (Lenient)
As a Function of Sorting Stability--
Main Experiment

Group	Subject Matter	P(R/Stable)	P(R/Unstable)
S	History (n=8)	.49	.31
	Botany (n=7)	.43	.36
	Economics (n=5)	.31	.27
C-2	History (n=8)	.33	.38
	Botany (n=5)	.31	.16
	Economics (n=6)	.30	.41
M-2	History (n=7)	.46	.51
	Botany (n=4)	.51	.19
	Economics (n=8)	.37	.41
M-6	History (n=8)	.58	.25
	Botany (n=5)	.46	.52
	Economics (n=8)	.43	.29
C-6	History (n=8)	.51	.57
	Botany (n=7)	.36	.37
	Economics (n=8)	.44	.18
		$\bar{X}$ = .42	$\bar{X}$ = .35

The second analysis was of the type used by Mandler (1967) described in Chapter I of this report. It was used to answer the question of whether the subjects clustered their sentences in recall according to the piles into which they sorted them, as was found by Mandler with word lists. Bousfield's (1953) RR measure was used as an index of the amount of clustering which occurred. RR is defined as R/(N-1), where R equals the number of times a sentence from a category (sorting pile) immediately follows another sentence from the same category in recall sequence, and where N equals the total number of sentences recalled. Random, maximum, and obtained RR scores were computed for each subject. The random RR value was determined by randomizing the order of the sentences recalled by each subject and computing RR for the sentences in that random order. The maximum RR was obtained by computing that value which would have been obtained had each subject recalled the sentences in each sorting pile as a single cluster. The obtained RR was simply the value calculated for each subject, according to the order in which he actually recalled the sentences. If clustering occurred at a level greater than that expected by chance alone, this would be reflected by the obtained RR values being higher than corresponding values of random RR. The maximum RR values set the upper limit, and are necessary since this limit varies with the number of piles used in sorting. Figure 4 shows the mean random, obtained, and maximum values of RR for groups sorting into two and six piles. This figure indicates that there is no evidence for clustering occurring in either the two or six pile conditions and, hence, no difference in clustering with number of piles used in sorting. Apparently subjects recalling these types of thematic sentences do not cluster them according to the organization used in sorting, as is found with words in word list studies.

Given these analyses, it is now possible to answer the questions concerning the relationship between number of piles used in sorting and recall.

4 a. Is the recall of thematically related material influenced by the number of piles used in organizing it? Unfortunately, the answer to this question is complicated.

The results have supported a sex-limited Mandler effect; that is, females appear to reliably recall more sentences after sorting into six piles than into two, whereas males show no such relationship. There were no corresponding differences between males and females in time taken to complete the sorting task, with both males and females spending more time sorting into the larger number of piles, nor was there any evidence for the occurrence of clustering during recall based on the organization formed during the sorting task. Thus, there is no obvious explanation for the sex-limited Mandler effect,

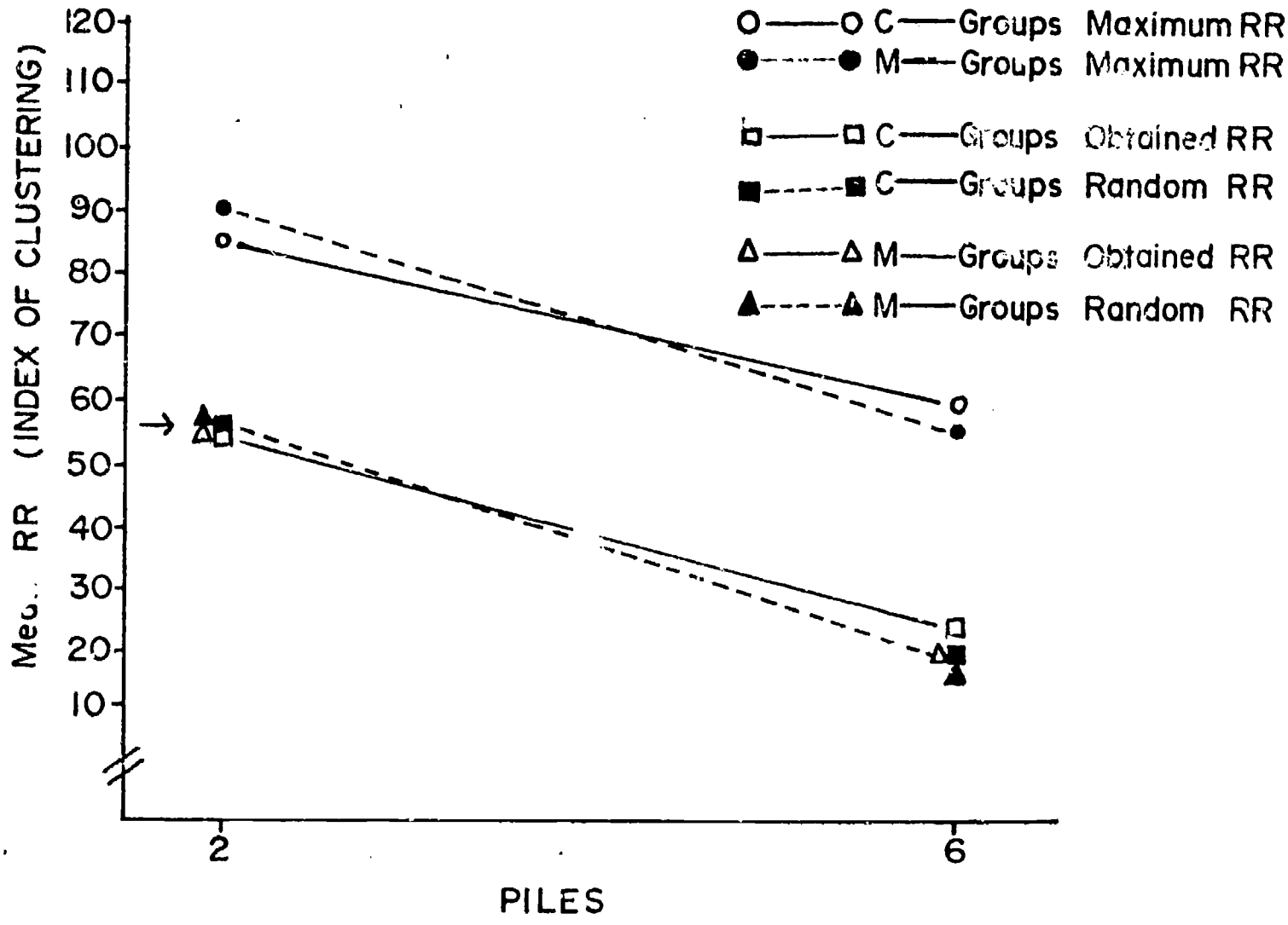

Fig. 4. Mean RR for groups C-2, C-6, M-2, & M-6 as a function of number of piles used in sorting —— Main Experiment

either on the basis of differences between sexes in sorting time (learning time) or in degree to which the information was subjectively organized.

The results of the three pilot studies also suggest that there is a greater likelihood of obtaining a difference in recall as a function of number of sorting piles if the sentences used are less strongly related to one another.

4 b. Is recall of main concepts and points affected by whether a person reads a passage related to those points he is asked to organize, or is mere exposure to the cards sufficient for recall in the Mandler sorting task? Results of the main experiment showed that reading the passage from which the sentences are derived significantly aids recall of the thematically related statements of main points. The average increase for the reading groups M-2 and M-6, compared to C-2 and C-6, was 2.1 sentences. Thus, it appears that subjects learn information during reading which aids them during recall. Whether the greater mean recall of the reading groups is a function of a retrieval system that is formed during reading or is merely a result of increased exposure to the material cannot be answered with the present data.

4 c. If the relationship between NC and R is obtained, is this relationship affected by reading a related passage? The answer to this question appears to be no, since there was no significant interaction in the recall data between whether subjects read a passage related to the sentences they sorted, and the number of piles they used in sorting.

Essay Data

In this section the results and some discussion of the analyses of the essay data will be presented. Like the previous section the scoring of the data will be explained first, then the general results will be given, followed by the analyses run to answer specific a priori questions. As with the recall data, a more complete discussion of the results will be reserved for Chapter V.

Treatment of the data. The three essay test questions, one each for the History, Botany and Economics passages, were chosen on the basis of three judges' agreement that a complete answer to each consisted of four major points, coupled with an explanation of each point. Three graders, each working independently, scored each subject's essay test. Thus each essay was given three scores, the mean of which was used in the following analyses. In scoring each essay

a grader would give up to two points for each of the main points a subject listed and up to two points for its substantiation. Graders were also instructed to give up to two "subjective" points for a particularly high quality essay. Thus, a perfect score on any essay test was 18 points. From Table 19 it can be seen that the reliability of the graders was rather high considering that they were scoring essays.

TABLE 19

Inter-Rater Reliability Matrix as Measured By Pearson-Product-Moment Correlations-- Main Experiment

	Rater 1	Rater 2	Rater 3
Rater 1	---	.85	.87
Rater 2		---	.88
Rater 3			---

Average inter-judge reliability coefficient: .87

General results. Table 20 contains the results of a 3-way analysis of variance conducted on the essay data. The independent variables were identical to those used in analyses of the recall data: sex, groups, and materials. As can be seen in the table, all main effects were significant. Females made higher scores than males (7.73 vs. 5.96 points), and the Economics question resulted in the lowest mean scores (3.83 vs. 8.43 and 8.29 for History and Botany, respectively).

TABLE 20

Results of 3-Way Analysis of Variance
On Essay Data--Main Experiment

Source	df	F	Probability Level
Main effects			
Sex	1, 144	9.781	.002**
Groups	7, 144	5.409	.001***
Materials	2, 144	30.292	.001***
2-way interactions			
SG	7, 144	.888	.518
SM	2, 144	.945	.391
GM	14, 144	1.112	.352
3-way interaction			
SGM	14, 144	1.948	.026*

*Significant at the .05 level
**Significant at the .01 level
***Significant at the .001 level

Table 21 shows the results of a Newman-Kuels test (Winer, 1962) on the mean test scores of each group.

TABLE 21

Mean Essay Test Score for Each of the Experimental Conditions--Main Experiment

Groups							
C-6	C-2	S	R-2	SM	R	M-6	M-2
3.9	4.5	6.7	6.9	6.9	8.4	8.4	8.6

Means with a common underline are not significant at the .05 level when tested by the Newman-Kuels test (Winer, 1962).

An examination of the means in that table indicates that they fall into three distinct clusters. As might be expected, the lowest cluster consisted of the two groups which did not read the passage relevant to the statements they sorted. Simply reading the concise statements of main points of the passage did not convey sufficient information about the total message of the passage to permit adequate performance on the essay test. These groups scored about half as many points as the highest groups. The second cluster of means was for experimental groups who either just read the passage twice or sorted the cards according to challenges, either a single challenge or multiple challenges. The cluster of means which was highest was that consisting of groups who sorted the main points, but for whom no external criterion was set for their organization. This included the group who simply read through the statements, and those who sorted into two and six piles. These groups were presumably allowed to organize the statements in their own fashion. The last two clusters of means, however, were not found to be significantly different in the statistical test. Further research is needed to see whether this tends to be a reliable finding. Only the 3-way interaction reached significance. Various ways of graphing the data were attempted, but none provided any consistent pattern that could be interpreted. The means and standard deviations for each cell contained in the analysis are reported in Appendix E.

A Priori Comparisons

As was stated earlier, identical a priori questions asked of the recall data were asked of the essay data. The questions and their concomitant analyses are presented below.

1. Does having a challenge by which to organize the important points of a passage produce different essay scores than does self-paced organization? An F test calculated on the mean scores of groups M-2 and S was not significant ($F(1,72)$ df = 3.01 $p < .10$). Thus it would appear that essay scores are not significantly influenced by whether a student organizes concepts using his own organizing scheme (M-2) or whether he is given a frame of reference by which to organize (S). This result follows the same pattern found with the recall data.

2. Does organizing the concepts and facts from three different frames of reference (using three different challenges) produce different essay scores than the more stable organization formed by three trials using the same challenge? The comparison between mean essay scores of groups S and SM was found to be non-significant ($F(1,144) = .03$ $p > .20$). This indicates that no difference in essay scores is produced by using three different challenges vs. one challenge as a basis for organizing the main points.

3. Does the task of organizing the main points of the passage produce better essay scores than simply reading the passage twice? Table 22 shows the results of Dunnett's multiple comparisons test (Winer, 1962) performed on the data. As can be readily seen, group R-2 did not differ from groups M-2, M-6, R, S and SM, all of which carried out sorting trials with cards bearing statements of the main points in the passage they read. Thus, there is no evidence that organizing the main points of a passage into categories results in better performance on an essay test than simply reading the passage again.

TABLE 22

Results of Multiple Comparison of Control R-2
With Sorting Groups That Read
A Relevant Passage

Comparison	Obtained T	Significance
R-2 vs. M-2	1.595	$p < .20$
R-2 vs. M-6	1.424	$p < .20$
R-2 vs. R	1.3853	$p < .20$
R-2 vs. S	.1414	$p > .20$
R-2 vs. SM	.0257	$p > .20$

Critical value of t, using Dunnett's procedure (Winer, 1962). .05 level--t (144 df) = 2.25 two-tailed.

Critical value of t, using a less conservative procedure (Bruning and Kintz, 1968). .05 level--t (144 df) = 1.96 two-tailed.

A 4-way analysis of variance similar to that performed on the recall data was performed on the essay scores of groups C-2, C-6, M-2 and M-6 to provide answers to the remaining a priori questions. Table 23 contains the results of this analysis. Only the main effects of reading and materials were significant. No other main effects or interactions were significant. Given these results the following questions can be answered.

TABLE 23

Results of a 4-Way Analysis of Variance of the Essay Data Of the Mandler Sorting Groups C-2, C-6, M-2 and M-6-- Main Experiment

Source	Obtained F	df	Probability Level
Main effects			
Sex	1.334	1, 72	.252
Reading	31.657	1, 72	.001*
Materials	8.292	2, 72	.001*
Piles	.241	1, 72	.625
2-way interactions			
SR	.057	1, 72	.812
SM	1.239	2, 72	.296
SP	1.563	1, 72	.215
RM	.924	2, 72	.402
MP	1.095	2, 72	.340
RP	.063	1, 72	.803
3-way interactions			
SRM	.838	2, 72	.437
SRP	.022	1, 72	.883
SMP	.983	2, 72	.379
RMP	.045	2, 72	.956
4-way interaction			
SRMP	.244	2, 72	.784

*Significant at the .001 level

4 a. Are essay test scores influenced by the number of piles used in sorting the main points and concepts of a passage? The answer to this question is no, since the main effect of piles was not significant.

4 b. If a relation between NC and essay scores is found, is this relationship affected by whether or not subjects read a related passage? This question is irrelevant, since no relationship was found between NC and recall.

4 c. **Regardless of whether a relation between NC and essay** scores is found, does the task of reading a passage and sorting related cards produce higher scores than merely organizing the main points of a passage? Clearly, the answer to this question is yes. **The group which read a passage related to the statements on the** cards they sorted (groups M-2 and M-6) scored higher on the essay test than groups which read an irrelevant passage instead (groups C-2 and C-6), and hence gained a better understanding of the tested subject matter. It is not clear, however, whether this benefit resulted from an exposure to more information about the topic through reading the passage, or simply through interacting with the relevant informaion, in whatever form, for a longer period of time.

CHAPTER V

IMPLICATIONS

In this chapter the results of the experiments will be discussed in terms of their implications in three major topic areas: previous research and theory on organization, memory and retrieval; the Structural Communication self-instructional technique; and general educational practice.

Implications for Theory of Organization, Memory and Retrieval

The relation between number of categories and recall. The results reported in Chapter II and IV indicate that the Mandler effect does occur when prose is used as the stimulus material in a learning task, but only under severely limited conditions. Apparently it is found only with female subjects when thematically-related sentences are sorted and recalled, thus suggesting a sex-limited Mandler effect. There is also some evidence that the effect occurs more reliably when the sentences are less closely related. Also, unlike past research with word recall, all of the present studies found that subjects sorting into more piles required more sorting time. Finally, the present studies found no evidence of clustering based on the piles into which subjects sorted the sentences; in word recall studies, such clustering has consistently occurred.

Taken together, this is a rather confusing set of results. There is no apparent reason for the Mandler effect being sex-limited. The differences in performance between males and females could not be explained either in terms of differences in time spent sorting, or differences in organization as indicated by clustering. The differences may in some way result from the fact that females typically show greater verbal ability than males (females did consistently recall more sentences in the studies reported here), but it is not clear why this caused them to show a Mandler effect while the males did not.

The complete absence of clustering was also an unexpected finding, in view of the consistency with which clustering is found in studies of word recall. There are several possible explanations for why this might have occurred. First, it may be that too few sorting trials were given to allow subjects to achieve a stable organization of the sentences. This is unlikely, however, in view of the stability of the sorting data from trials two to three. Collapsing data across subjects, .84 of the sentences were placed in identical piles on these two sorts, while .16 were changed from trial two to trial three. This seems to indicate that a stable organization had been formed by most of the subjects.

A second possibility is that recall of the type of sentences used in these studies is not based upon a cognitive organization. Thus, even though the subjects organized the sentences in the sorting task, the organization formed was not used for retrieval, and the sentences were recalled in a rather random order. The present studies did not provide adequate data for the testing of this possibility. Such a test would require either multiple recalls from each subject, or a larger number of subjects who learned the same materials under identical conditions, so that a measure such as Tulving's SO could be used to index any existing organization in the subjects' recall protocols. In view of the consistent findings of past research which has shown that recall of word lists proceeds in a very organized fashion, it seems most likely that such a test would reveal regularities in recall of sentences.

This leads to the third possibility, that the organization used to sort the cards in the sorting task was not the same as the organization used as the basis for recall. This assumes that some sort of organization was indeed formed during the learning task, and that recall was based upon it, but that it was not revealed in the sorting task. This seems strange, especially in the case of the C groups, whose only exposure to the information to be learned was limited to the sorting task. It would seem reasonable that as these groups organized the sentences into a coherent set of relationships, this organization would be reflected to some degree in the way they sorted the sentences. Interestingly, no evidence for this was found since the organization formed during sorting was not reflected in recall.

It is certainly possible, however, that thematically-related material such as the experimental sentences are interrelated in many ways. Because the sorting task requires a reliable partitioning of the sentences, it may require subjects to use relationships to complete the sorting task which are quite different from the types of relations that are activated by the necessity of recalling the sentences. Relationships on which recall is based may tend to be interrelationships among the items, such as the order of presentation,

logical connections or historical time sequences, whereas those used to sort the items may be relationships which allow for a reliable partitioning of the items, such as subtopics or persons discussed. For example, during the sorting of the History cards, the subjects could have placed all the cards with Mary's name in one pile, those with Mary and Pole in another, those with Gardiner's in another, etc. Their recall, on the other hand, may have been based on the historical sequence of Mary's life, rather than the sorting piles which were categorized by names. Thus the influence of the sorting piles on recall would tend to be negated. Again, the data of the present experiment are not appropriate to provide an adequate test of this alternative. Further research is clearly required on this issue.

Relation of results to Mandler's retrieval theory. As reviewed in Chapter I, Mandler has assumed that when a person learns a relatively large set of materials (words, in Mandler's research), he encodes the material into meaningful categories or "chunks," which then can become members of even higher level categories. This process leads to a hierarchical type of cognitive organization. Mandler has assumed that the sorting task he used reveals at least some of this organization to the experimenter. Retrieval from memory is seen as an active search process with the organized categories serving as retrieval cues. If an item is to be remembered, it must be adopted into this hierarchical organization. Limitations on the retrieval system make it unlikely that more than about five members of a particular category will be recalled in any given attempt. Thus, retrieval from this system is highly dependent upon the organization formed at the time of learning. Both the number of items recalled and the order in which they are recalled should be greatly affected by the form of the organization.

The research described in this report has clearly shown that a direct application of Mandler's approach to the learning of information from prose is not successful. None of the results predicted by Mandler's theory have been found unambiguously in the data. The relationship between number of piles used in sorting and the number of items recalled was found only for females in the main experiment. The results of the pilot studies have suggested that such a relationship may be found when statements used in the sorting task are not thematically related into a single structure. This suggests that the Mandler effect is found most reliably when subjects are asked to learn relatively unrelated items such as the typically used word lists, and that added structure in the stimulus materials may reduce the effect.

Another finding that conflicts with Mandler's approach is the complete lack in recall of clustering on the basis of sorting categories. At the very least, this indicates that subjects' recall is

based on some form of organization other than that revealed by the sorting task. These negative results cast doubt on Mandler's theory of storage and retrieval because they do not duplicate the pattern of results he found using word lists on which his theory is based. Thus it appears that the simple, hierarchical form of cognitive organization which he assumes underlies the learning and retrieval of large amounts of information may be too simple a description to account for the learning and recall of information from prose.

As pointed out earlier, these results cannot be accepted as clear evidence that recall of related sentences is independent of some type of cognitive organization. Rather, they rule out the possibility that the categorical organization formed during sorting serves as the basis for recall, thus leaving the alternative that subjects use other forms of organization for retrieval to be explored.

It is clear that further research is needed in extending the theory that recall is dependent upon the organization formed during learning in order for it to account for learning from prose. It appears that such research must permit the identification of other and probably more complex relationships among the materials to be learned than those examined in the present studies.

Implications for the Structural Communication Theory and Method

In an earlier discussion (Chapter I) it was pointed out that the developers of the Structural Communication Curriculum technique believe that a student's understanding of the topic area covered by a study unit is enhanced by working through the entire unit with all its parts. In fact, they imply that the technique promotes greater understanding than other self-instructional methods (Systematics, 1967). In the present study, however, only the organizational variables inherent in responding to problems posed by challenges using items similar to those found in the Response Indicators of study units were investigated. Subjects did not work through the Discussion Comments, nor read the Viewpoints sections of their study units. Thus, the present research should not be construed as a test of the effectiveness of the total Structural Communication method.

The importance of responding to challenges for promoting understanding on the part of the learner is, however, greatly stressed by the method's developers. They state that the Investigation and Response Indicator sections of a study unit are where understanding is initiated, and seem to imply that these sections are very important pedagogically (Systematics, 1967, pp. 248-249). Because the main experiment investigated the effects of similar sections on developing an intuitive grasp of the material, the essay results

(presumably a measure of understanding) have important theoretical and practical implications for the method and, therefore, will now be detailed.

The results of the essay data failed to show any advantage in performance resulting from using a single challenge for sorting the main ideas from the passage, or from using a series of challenges by which the main ideas might be related to a number of different issues. In fact the data favored, though not significantly, those groups who read a passage and who were simply allowed to organize related statements into their own system, rather than relating the statements to challenges given to them by the experimenter. Interestingly, the groups who sorted according to challenges received scores very similar to the group that was only allowed to re-read the passage and was not allowed to learn the main points on the cards.

While these results do not argue against the hypothesis that Structural Communication leads to better understanding when the entire study unit is learned, the results do indicate that the Investigation and Response Indicator sections of the study unit produce no better understanding of the material than do other learning methods. They also bring into question the theoretical assumption of Structural Communication's founders (outlined in Chapter I) that a challenge is a necessary condition for raising the level of a student's mental operation and, hence, his understanding. Thus, unless the rather untenable assumption is made that the tasks of the other groups used in this research are analogous to challenges, these results suggest that the founder's theory of mental operations may be inadequate.

Clearly, further research should be conducted to determine whether freely developed or self organization is reliably superior to that formed in response to challenges, as the essay as well as the recall data tends to suggest. If it is, it suggests that the theory on which Structural Communication is founded be changed to stress the importance of placing fewer constraints on mental functioning and, consequently, that the Structural Communication method itself be changed by incorporating a less restrictive technique by which students are asked to organize the points found in the Response Indicator matrix. However, since these ideas are based on non-significant differences among the groups, they should be regarded as merely suggestive.

Implications for Educational Practice

The studies described in this report were stimulated by research in verbal learning which has shown the importance of organization of information for its subsequent availability for recall.

The evidence is strong that organization not only has an important influence on what can be recalled, but it may be a necessary prerequisite for recall. This research seems closely related to some theorizing in educational psychology, such as Ausubel's (1968) theory of meaningful learning which stresses the importance of interrelationships among the information learned, and to the constant advice given by educators that students should organize the information they are learning. It is clear that research on the relationship between organization of information from prose, and its later recall, is very important for educational theory and practice.

Two general problems needing research are evident. One is an investigation into various types of organization which might be formed by the learner, and the effects of each on recall, and the second is the identification of ways of facilitating the formation of appropriate forms of organization as students study. The present research was aimed at contributing to both of these problems. The results have shown, however, more about what does not have an influence than what does. Still, this is important because of the fact that the techniques used have been straightforward applications of research methods which, because of their success with the learning of other materials, were strong contenders as methods which might influence recall from prose. This research also tested selected organizational methods which are contained in an interesting new instructional technique which claims to produce superior learning.

In summary, the research results indicate that the type of organization formed through a sorting task, whether with single or multiple criteria, is not successful in reliably affecting that aspect of subjective organization which is important for later recall. Thus, the sorting task appears to fail as a device of externalizing that aspect of subjective organization on which retrieval is based, and it also fails as a means of aiding students to more adequately organize their information for recall. There is no evidence that giving students "challenges" which induce them to partition the main points in a passage in different ways leads them to a deeper understanding of the information than would be the case through simply allowing them extra time to read the passage or to organize the main points of the passage in their own way. The research also provides evidence for a difference between males and females in the effect that the sorting task has on their later recall, a difference for which the authors can offer no explanation.

All this seems to suggest that future research on the relationship between subjective organization and recall with prose materials must provide means of investigating more complex forms of organization as being important for recall and understanding. In view of

the frequent claims made for the importance of organization in learning in educational situations, further research on this problem is sorely needed. Perhaps the present study can serve to suggest directions for this research, and particularly to stand as evidence that the final answers will not be simple extensions of concepts presently available from research on the learning of word lists.

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APPENDIX A

Sample Structural Communication study unit

MARY TUDOR AND THE REACTION

INTENTION

Seventy years have passed since Henry VII linked the name of Tudor with the English throne. We have seen how the first Tudor monarch and his son worked to strengthen the throne, and some of the effects of their exercise of the kingship. The crisis following Henry VIII's death was largely due to the fact that there was really no acceptable alternative to royal government which people generally could understand or make work. After the ineffectual Somerset and the rapacious Northumberland had failed to employ the machinery of government in the way and for the purposes for which it had been designed, the throne passed to a woman. Henry VIII had dreaded such an eventuality. He had spent such effort in the 1520s and wrought such changes to avoid it. In this Study Unit we see just how far his fears were justified.

Mary ascended the throne of a country which was, according to the statutes of its Parliament, Protestant in form and doctrine. Yet Mary was one of the most extreme Catholics in Europe. She was determined to return England to the Roman faith, and was determined also to try to get back for the Church the massive wealth which had been drained from it, and which had supplied a new strength and confidence to a whole class of English society.

We see in this Study Unit how the inevitable clash between this Catholic Queen and her Protestant landowning subjects was handled, and some of the effects of her efforts to force England to accept Catholicism.

PRESENTATION

The tragic life and reign of Mary Tudor. A "tragedy" can be defined as the destruction or failure of a sympathetic character because of one weakness. In this sense Mary's reign, and indeed her whole life, can be viewed as a tragedy. Her "weakness" (in the dramatic sense; she certainly considered it her strength and consolation in reality) was Catholicism, tinged as it was for her with loyalty to Spain.

Her youth was filled with memories of her father, Henry VIII, trying to get a divorce from her mother, Catherine of Aragon, in order that he might marry the young Anne Boleyn, with whom he was infatuated. Thereafter she watched the destruction of the religion she loved and had taken solace from. Later she had to suffer the horror of being declared illegitimate so that her half-brother, Edward, should succeed to the throne rather than she.

But after it all, even after the gallop towards Protestantism of Edward's reign, she did inherit the throne. She became Queen, with all the powers of the English monarchy in her control. She was no weakling; she had courage and had determined how she would use the power that fell at last into her hands. The problems were clear to her mind, and she tackled them with strength and vigour. Yet, somehow, like everything in her sad life, nothing went right.

One of the words which seems to sum up so much of Mary Tudor's reign is "irony". She was courageous, intelligent, and—in all but religious matters—a merciful and generous woman. But her religious intolerance and the foreign policy she insisted on pursuing, despite the advice of her Council and Parliament, brought about one of the most dangerous rebellions of the century, hatred for the Church she loved and for herself, and the failure of all her hopes.

Female, Catholic and Spanish. Mary Tudor was the first woman to have undisputed rule over England. Previously Matilda, in the twelfth century, had been the only woman to lay claim to the throne, and her "reign" had been spent in continual fighting with her cousin Stephen. That period of history was remembered as "The Anarchy", and associating the rule of a woman with fighting and chaos, it was with some foreboding that men in the mid-sixteenth century looked forward to the rule of another woman.

Mary was the daughter of Catherine of Aragon

and was proud of her Spanish ancestry. She was also proud of her Catholicism, and passionately devoted to the idea—which she seems to have considered a "vocation"—of returning England to the flock of the papal shepherd. She came to the English throne at a critical moment in the struggle between the Habsburg and Valois houses, and Mary's Spanish preference was a decisive factor in committing England to a further fruitless and damaging part in the battle between the great powers of Europe. The alliance which she formed with the Emperor Charles V, cemented by her marriage to his son, who was to become Philip II of Spain, was perhaps appropriate, as her father and mother had been married to cement Henry VII's alliance with a Spanish monarch half a century earlier.

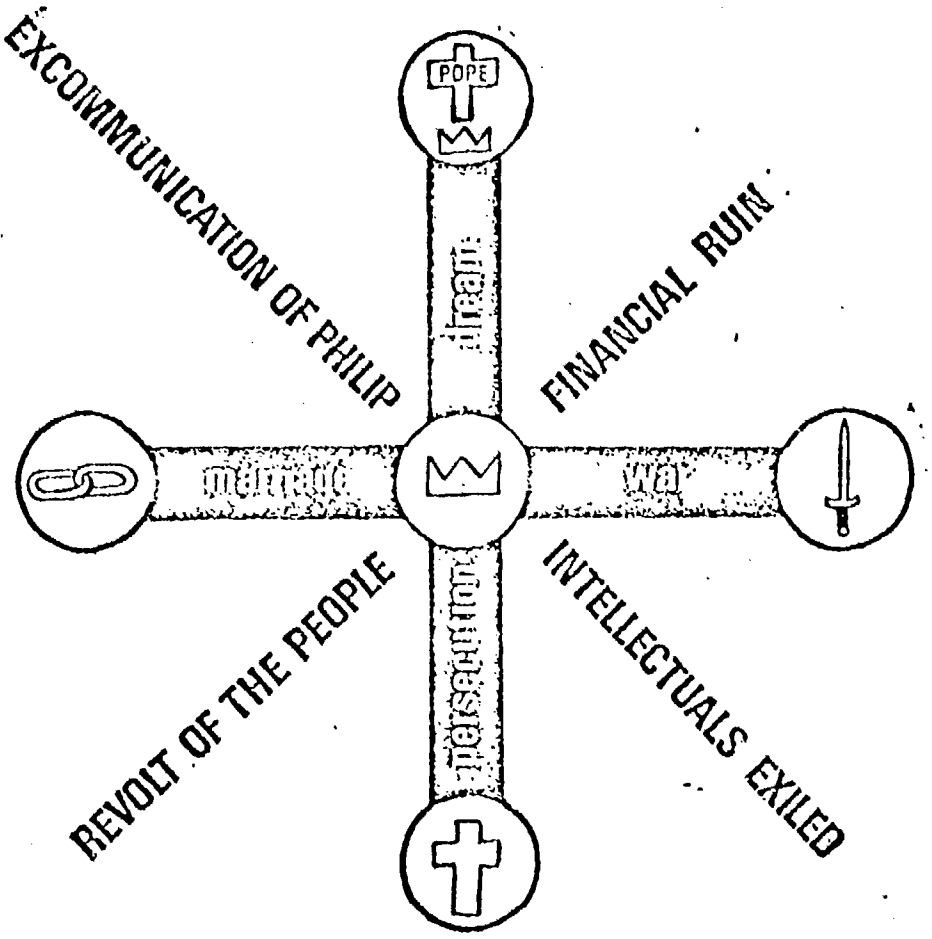
Patriotic Englishmen were worried that such an alliance would simply reduce England to a Spanish colony, and they were to see their fears proved justified by the events of the next few years. Almost every member of her large and unwieldy Council opposed Mary's marriage, and it was only by showing that she had inherited not just the Tudor intelligence, but also their ferocious will and violent temper that she managed to threaten and persuade them all, one by one in private meetings, to accept her wishes.

Stephen Gardiner, for so long near the centre of power yet never given the positions that his talents warranted, found himself at last as the Queen's chief minister and Chancellor of England—having been released from the Tower to take up his new honours. He had spent many years out of office because of his Catholic beliefs, and also because Henry VIII never really liked or trusted him. Henry had found his gruff, outspoken manner, which too often verged on the border of boorishness and rudeness, not at all congenial. His Catholicism had earned him a place in the Tower during the rule of Northumberland and now, ironically, at last in power, he found his time and energy being spent on restraining a monarch who was a more radical and passionate Catholic than himself. While by no means renowned for diplomacy himself, at least he was able to see that his new sovereign's attempt to drag England headlong back to Catholicism would have to be handled with a delicacy and caution which Mary only too clearly lacked.

Opposition. Another of the ironies of Mary's reign was the fact that she inherited the title of Supreme Head of the Church, and she was to find that in England the statute law of Parliament seemed to count for more than her view of God's law; and the Parliament who gave her father the title refused to remove it from her. Gardiner prevented her simply declaring all Henry's and Edward's religious legislation null and void, and managed thereby to avoid possible rebellion. While religious feeling might not have been the well-spring of such revolt, the dedication of so many lords and gentry to their Church lands and property easily could have been.

The first Parliament of her reign quickly showed the tenor of feeling about the issues which faced the country. It was made very clear that while a return to Catholic doctrine could be won easily, there was to be no return of Church lands. Parliament, whose confidence and power seems to have been greatly increased by being the instrument of the Reformation in the 1530s, and so being one of the anchors of the governments during Edward's reign, sent a complaint to Mary about her proposed marriage to Philip. Mary's reaction was simply to push ahead with the marriage, which was celebrated by proxy in October of 1553.

Mary's mercifulness prevented large-scale executions for the plot hatched by Northumberland to deprive her of the throne. Only three died for that treason. Her concern was not with the laws of England but with the laws of God, as she saw them. During the first months of 1554, however, one of the most dangerous revolts of the century took place. It was not the biggest or most widespread, but it was led with determination, and clarity of purpose, and it took place close to London. Sir Thomas Wyatt led 3,000 men of Kent on the capital. Finding London Bridge defended, the group passed up river and crossed the Thames at Kingston, and from there marched on the city. Wyatt and his followers were motivated by opposition to Catholicism, and a resentment against the Spanish marriage which they felt would be disastrous for England. The rebel



forces got right to the walls of the city, and were only overcome with difficulty in confused street fighting centred on Fleet Street.

Mary was again reluctant to allow executions to follow for mere acts of treason, but the counsels of Gardiner and the powerful though distant voice of her father-in-law, the Emperor Charles V, prevailed. Wyatt and many followers were executed in London and Kent. The lovely and innocent Lady Jane Grey and her husband, Northumberland's son, were sent to the scaffold as well. Mary's young sister Elizabeth, in whose name Wyatt led his rebellion, was perhaps fortunate not to find herself on a scaffold with her champion. The result of the revolt was the opposite of what was intended. Instead of overthrowing Mary, it made people, realize that the danger of anarchy was still very real, and so support for her and, reluctantly perhaps, her policies was reinforced.

Mary was 37 years old on her marriage to Philip, and her hope to keep England faithful to the Church of Rome (once she had reestablished England's obedience to the Pope and the Pope's forgiveness of the stray sheep) rested on her providing an heir to the throne. If she died without a child, her sister Elizabeth would succeed, and Elizabeth's religious feelings were most suspect. In July 1554, Philip at last arrived in person, and the marriage was celebrated to less than warm rejoicing throughout the country. But Mary was, for a while, happy. She loved her husband, and seemed unaware that he did not love her in return.

The imposition of catholicism. Mary's constant preoccupation was the return of her country to Catholicism. By her authority as Supreme Head of the Church—a power she felt was contrary to the laws of God—she had reversed the religious advances of Edward's reign. She had also ejected thousands of clergy for heretical opinions, and for taking wives. The more advanced and powerful Protestants had been removed from their bishopries and mercifully given time to flee to the Continent, which large numbers did. They went to centres of the Continental Protestant Reformation, and there learned more extreme doctrines and gathered a new and passionate enthusiasm, which they were to bring back to England after Mary's death. Others, how-

ever, stayed and were to form the core of the most prominent Protestant martyrs of the reign. Cranmer himself was in the Tower charged with treason. Hooper, Ridley and Latimer also stayed to face whatever was to come.

Cardinal Reginald Pole was made the Pope's Legate, committed with the task of returning England to the body of Christendom. Pole, himself English and related to the royal house, was perhaps as bad a choice for this delicate job as could have been found. Like Mary he was personally kind and merciful, but also like Mary he was a religious fanatic. He was unwilling to accept any compromise and it was only after the greatest efforts by Charles V and the more realistic English ministers, including Gardiner, that Pole accepted that there would be no return of Church lands before England could be received back into the Roman fold. In November 1544 Pole reached England, and Parliament showed its repentance by repealing all the anti-papal legislation passed since 1529, and on its knees received the Pope's forgiveness.

Mary and Cardinal Pole were determined to obliterate the last vestige of heresy in England, and thought the best method to achieve this end was by force. They felt that only by such means—by destroying the bodies—would it be possible to save English souls, and they also thought it would only need a few burnings to bring the rest of the Protestants cowering back to the Roman Church. So, early in 1555 the heresy trials began. Most of the 300 victims of Mary's religious fanaticism were from the lower classes. Hardly any gentry or nobles, who were not also clerics, found their way to a martyr's death. Cranmer, Ridley, Latimer and Hooper provided the most prominent Protestant martyrs and, as Latimer predicted to Ridley while the flames enveloped them, the torch that was lit there was to spread across England.

Mary had done the unforgiveable. England was used to seeing the law employed in the disposing of men who were a danger to the throne. Even men like Thomas More could be executed by the Crown and there would be little disturbance, because a quick and violent death was one of the risks attached to being close to power and wealth in these times. Order was always on a delicate balance, and royal power was the guarantee of that order. If any man threatened that power, he threatened the stability of the country, and for such a threat the penalty was death. But Mary was not playing according to the accepted rules. She was burning ordinary commoners who were no threat to her throne for their religious opinions. It was just what so many had most feared. Even though Philip tried to restrain his wife and Cardinal Pole in their zeal, English people had indelibly drawn on their mind the fact that such cruelty was typical of foreign, Spanish, practice. It was not English. Spain and "Catholic" were beginning to be associated in English minds too, and Mary, in giving the Protestant Church its 300 martyrs, was laying a firm foundation for the loyalty to Protestantism and the deep antagonism to Catholicism which was to be typical of England for centuries.

Towards a bitter end. Late in 1555 Stephen Gardiner died, having understood the futility of the burning of heretics. By his death one of the few restraining influences on Mary was removed. Mary's tragic life had still three years to run. Her husband Philip had left her to go and take over his inheritance, Spain. There was no child to inherit the throne. And things got worse.

Pope Paul IV quarrelled with Philip, excommunicating him, and later quarrelled with Pole, depriving him of his position as Papal Legate in England. Such distress to Mary was aggravated further in 1557 when the war between Spain and France was renewed. Philip returned to England to persuade his still infatuated Queen to lend her country's help to his cause. Overriding all objections from her Council, Mary continued to fulfil the worst fears of her subjects. Without any reason, from an English point of view, war was declared with France and desperate and illegal measures were resorted to in raising the money to pay for the absurd adventure. Englishmen saw their country used to further Spain's interests and worst of all, they saw their country sacrificing its own interests for Spanish ones. Early in 1558 England's last possession on the Continent, Calais, was overrun by the French. Since

the decline of the wool trade which passed through Calais, that foothold on the Continent had been merely an expensive burden, not in any way repaying the cost of its upkeep and defence, except in prestige and pride. With the loss of Calais, it was English prestige and pride that were broken, and all the resulting anger and bitterness was turned on Mary.

All these disappointments in the things she most wanted broke her heart. The child she was still desperately, almost hysterically, hoping for was not to come, and it was clear to all that soon England would have a new Queen. Mary died in November 1558, and her ally Cardinal Pole died within hours. The return to Catholicism died with them, and England waited in doubt and not a little fear to see what the reign of the fifth Tudor would bring.

INVESTIGATION

Problem 1

When Mary came to the throne in 1553 England was, at least in its official doctrine and organization, a Protestant country. Mary's ambition was to reconvert England to Catholicism, and she was ready to use every power at the disposal of the monarchy and government to achieve this end. There were factors which favoured her ambition and others which hindered it. Despite the latter, within a few years England was again Catholic and in full communion with Rome.

Consider why it was that Mary could have been able to reconvert England and have this reconversion ratified in statute law by the English Parliament.

Use the RESPONSE INDICATOR to explain why she was able to achieve her ambition of returning England to Catholicism.

Problem 2

England had been intermittently involved during the first half of the century in the struggle for power between France and Spain. But Englishmen had learned that it was not a struggle from which they could hope to gain much. Both of the giant Continental powers were happy to have English help, but neither was willing to give very much for it. Henry VIII's adventures abroad had cost the country dearly, and would have made him bankrupt had he not been provided with money from the sale of the monasteries' lands and wealth.

Bearing in mind these earlier unhappy, and generally inglorious, involvements in Continental wars, what do you suppose led Mary to take her country into the conflict again, in circumstances which seemed to offer no prospects of gains to England?

Use the RESPONSE INDICATOR to explain what led to Mary involving England in war with France.

Problem 3

After so much hope to do good for her country when she came to the throne, Mary finished her life in bitter despair. Again we see in her reign a course run from one extreme to another.

Imagine yourself in Mary's position as her reign drew to a close. Consider how she would have looked back over her reign and life. What areas from her years on the throne would have stood out as her major disappointments?

Use the RESPONSE INDICATOR to construct a picture of Mary's disappointments.

Problem 4

Mary owed her throne to popular uprisings in her favour. English people on the whole welcomed her as a Tudor and as their rightful sovereign. Yet within five years almost all her subjects hated her and longed for a change of ruler.

Try to put yourself in the place of one of Mary's subjects—either one of the "politically significant" or "insignificant". Consider how an ordinary person of that period, who supported Mary against Northumberland, could come to dislike her so intensely in such a short time.

Use the RESPONSE INDICATOR to construct an explanation of why there was this massive swing in public opinion in so short a time.

RESPONSE INDICATOR

Mary executed common people, not simply those who were powerful and a threat to the throne. 1	Mary married Philip II of Spain. 2	Cardinal Pole was deprived of his legateship. 3	Stephen Gardiner's death removed one of the principal restraints on Mary. 4
Mary was aggressively proud of her Spanish ancestry. 5	Mary was unable to have a child. 6	Sir Thomas Wyatt's rebellion rallied support for Mary at a crucial time. 7	300 Protestants were burned for their religious beliefs. 8
Calais was lost to the French. 9	By the time of Edward's death, Protestantism had not got any deep support amongst the common people. 10	Mary's political folly involved England in a war which was not in its interests. 11	Parliament refused to remove from Mary the title Supreme Head of the English Church. 12
To pay for the war with France it was necessary to raise money from her subjects. 13	Those who benefited from the despoiling of Church property refused to return it. 14	Mary ejected thousands of Protestant clergy from their parishes. 15	Mary formed an alliance with the Emperor Charles V. 16
Stephen Gardiner wisely insisted that the religious changes would have to be passed by Parliament. 17	Mary was infatuated with her husband and thus he was easily able to persuade her to support his policies. 18	Protestant bishops and theologians fled to Protestant centres on the Continent. 19	The policy of the government depended largely on the will of the monarch. 20

DISCUSSION GUIDE

Problem 1

1.	I	8	A
2.	I	2 or 16	B
3.	O	12 or 17	C
4.	O	10 or 20	D
5.	O	15 or 19	E
6.	O	7	F
7.	I	any three or more of 1, 3, 4, 5, 6, 9, 11, 13, 14 and 18	G

Problem 2

1.	I	9	H
2.	O	2, 16 or 18	I
3.	O	11 and 20	J
4.	O	4 or 5	K
5.	I	any three or more of 1, 3, 6, 7, 8, 10, 12, 13, 14, 15, 17 and 19	G

Problem 3

1.	I	any two or more of 1, 8 or 19	L
2.	O	17	M
3.	O	6 or 9	N
4.	O	3, 12 or 14	O
5.	I	any two or more of 2, 4, 5, 7, 8, 10, 11, 13, 15, 16, 18 and 20	G

Problem 4

1.	O	15 and 16	P
2.	O	1 or 8	Q
3.	O	any two or more of 2, 5, 9, 11, 13 or 18	R
4.	I	any two or more of 3, 4, 6, 7, 10, 12, 14, 17, 19 and 20	G

DISCUSSION COMMENTS

A

It is always difficult to assess just how a group of people would react to something like the threat of burning if they did not accept the religious beliefs of the ruler of the State. No doubt there would be just about as many different reactions as there were different people. Certainly, as you imply by including this factor, many would have been frightened and would accept Catholicism through fear of this terrible death. But on the other hand, the burning of Protestants began to supply the strength of loyalty to the new faith that it had hitherto lacked in England. So, perhaps, while this terror may have made it easier for Mary to re-reform English religion, it was decisive in ensuring that England would grow to hate Catholicism after the State's enforcement of it ended.

B

I don't think that Mary's connection with Charles V, or the closer connection of marriage with his son Philip II, really made things easier for her. She was determined to reconvert England, and had the strength of personality and intelligence to hold together all the powers of the monarchy and direct them as she wished. So I think she would have done it without help or encouragement from Charles or Philip, and indeed I suspect that the opposition she encountered because of her unpopular marriage with Philip probably made things more difficult. Still, who can know? You may be right. After all, everyone needs support and help, and Mary was getting precious little from her own countrymen. Perhaps Charles and Philip did help to give her that extra determination.

C

Mary wanted to ignore Parliament in returning England to obedience to Rome. She felt that the statute law of England's Parliament was in conflict with the law of God—and that in such a case Parliament's law was meaningless. Gardiner, being a sounder politician than Mary, insisted that Parliament be used to take from the statute books those laws which it had put there in the first place. By thus respecting Parliament, they avoided possible trouble. Since Parliament automatically gave the title of "Supreme Head of the English Church" to the reigning monarch, Mary found herself with a power over the Church which she felt to be contrary to God's law but which was, ironically, very useful in bringing about the changes that she wanted.

D

By the time of Edward's death, Protestantism largely owed its speedy advance in England to its association with the political and economic interests of the most powerful groups in the country. There is little to indicate that there was any widespread popular devotion to the new faith. This being the case, the monarch's will was decisive. Government depended almost entirely on the initiative from the centre—from the monarch and Council. With Mary, the most radical and passionate Catholic in the country came to the throne, and this fact, combined with the lack of deep commitment to Protestantism in 1553, allowed her re-Reformation to go ahead without violent opposition.

E

Mary owed a large part of her success to removing from the Church some of the major sources of opposition to her religious policy. She removed thousands of clerics (though many seem simply to have gone to different parishes) because of their Protestant views or because they had married, and she allowed Protestant bishops and theologians to escape to the Continent, leaving the most powerful positions in the Church to be filled by Catholics. Had these men stayed and offered a stiff resistance to Mary, no doubt many, if not all, would have ended in the flames along with Cranmer, Ridley and Latimer. But they might have been able to cause a bit of trouble before such a fate caught them. Their flight abroad eased Mary's mind, and certainly allowed her to re-reform more easily and smoothly.

F

Most English people were deeply concerned with order. On the whole they were ready to sacrifice quite a bit to preserve the peace. While many people were ready to oppose Mary's religious policy for one reason or another, most were willing to sacrifice their particular wishes when it seemed that law and order were in the balance. Thomas Wyatt's rebellion had the effect of rallying behind Mary the support of many of those who might otherwise have offered political opposition to her proposed changes.

G

I have interpreted all these statements as more or less irrelevant to the problem as I see it. It might be that you have seen a connection which I thought too indirect to comment on, or perhaps you have not understood exactly what the problem is concerned with. It may be that you have confused the time scale, or included causes rather than effects, or effects rather than causes. Or it may be that the connection you have seen is a perfectly good one which has escaped me. Whatever the reason, if you re-read the problem and the relevant part of the PRESENTATION you should in most cases be able to work out why the statements you included are not discussed specifically.

H

This would be useful in building a picture of the results of the war rather than of its causes. Mary hardly entered the war with the intention of losing Calais. She was so shattered by its loss that she said that "Calais" would be engraved on her heart even after she was dead.

I

Mary's Spanish descent and love of things Spanish led her to enter the alliance with Charles V, which was cemented by her marriage to his son Philip, who was to become the King of Spain. Her love for

Philip meant that he was easily able to persuade her to his will—and when this was to get England to join the war against France, Mary soon agreed despite all warning to the contrary. The alliance with the Emperor Charles V was directed against France. I think that this combination of factors explains much of what happened to England under Mary. The almost autocratic power of the monarch meant that the whole country's policy depended almost entirely on her will.

J

These together indicate that a country could pursue a disastrous policy simply because it was something the monarch wished. Mary, in her folly, overruled all the advice of her Councillors and Parliament. She used all her powers as monarch, and in doing so showed that it was possible for the monarch, to bend the whole country to her will. The monarchy was too important to stable political, social and economic life for people to be ready to try to overthrow it, even over what was clearly a disastrous foreign policy.

K

It is difficult to know how much of a restraining effect Gardiner was able to exert on Mary. Certainly he gave her some good advice and managed to apply some modifying influence on her attempts to bulldoze her wishes into practice. Earlier Gardiner himself had been in favour of alliance with France rather than Spain, but nothing could have been done to prevent Mary indulging her "Spanish passion" in allying with the Habsburgs, and thereafter it is doubtful whether Gardiner could have altered materially the course that Mary pursued. But I still think that Gardiner's death could be included to add to the picture of why Mary led England into war with France. He was one of the few men whom she relied on and trusted, and he was dubious about most of Mary's enthusiasms. With his death even this gruff, rather rude, but basically sane voice was removed.

L

I don't think it was really a disappointment to Mary that the Protestant bishops fled abroad. She had not wanted to imprison them in England, and even allowed them the opportunity to get away. Here again, however, in this reign full of ironies, Mary achieved the opposite of what she intended, and perhaps for this reason this could be included amongst her disappointments. The bishops and theologians who fled went to the centres of Protestant influence abroad, and there imbibed the faith and ideas which they were to bring back with them after Mary's death. I think the same is probably true of her treatment of the Protestant martyrs. She was not cruel, and certainly got no pleasure out of burning people. Again, ironically, the burnings had exactly the opposite effect from that she intended. Instead of crushing Protestantism they gave it new life, and in this there was no doubt disappointment for her.

M

Mary had been reluctant to negotiate the re-Reformation through Parliament. She had wanted simply to use the power of the monarchy to give what to her seemed the great gift and blessing of the reconnection with Rome and of the Pope's forgiveness to her country. But continually her Parliament seemed more concerned about its ex-monastic property and its own laws than the Pope's forgiveness. She saw herself offering a gift beyond all others to people who, before they accepted it, demanded that they sit down and negotiate about what to her appeared trivial matters. I think this came as a shock to the deeply religious Mary, and I feel sure she would certainly have classed it amongst her disappointments.

N

Mary's hopes for Catholicism lay in the uprooting of Protestantism and preserving England in its restored obedience to Rome. Her best chance of this lay in producing a child of her own to inherit the throne—but she was to be disappointed in this as in so many things. The war she had engaged in brought only loss—the most spectacular, and hurtful to her, being the loss of Calais. I think these two items are essential to a picture of Mary's disappointments.

O

The central theme of Mary's life was her dedication to her religion. The central hope of her reign was to return England to the Church of Rome. In the failures she met in this ambition lay her bitterest disappointments. The English Parliament seemed always more concerned about its property and laws than in the offer of forgiveness and absolution from the Church of Rome, and they agreed to rejoin the Roman Church only on condition that they should be able to keep the property. To crown it all, Mary had to see her husband excommunicated and her ardent helper, Cardinal Pole, deprived of the papal legateship which seemed the channel of grace from the Pope and God. The immediate changes that she managed to put into operation were achieved by the power, inherent in the kingship since her father's reign, of the Headship of the English Church. This was of course a power which, in her view, conflicted with the laws of the Roman Church, and thus also conflicted with God's laws. And yet her Parliament would not remove the title from her. Her stern conscience had to try to accept this unhappy situation too.

P

Either of the two items which brought you to this Comment could certainly be used to explain how Mary lost some popularity. The ejection of Protestant clerics would have annoyed some—if only the clerics themselves. The alliance with Charles V would have annoyed many of those who preferred a French alliance, or no alliances at all. But such opposition was relatively insignificant, I think, when compared with the later political blunders of her reign.

Q

England was to remember its first reigning Tudor Queen as "Bloody Mary". The scale of public executions of common people during her reign was something England had never experienced before. It is a further irony that this gentlest of the Tudors should be remembered for merciless violence. Her religious dedication and conviction was total. She felt that her vocation was to save English souls, and to do it she did not shrink from destroying their bodies. Her reward was the failure of her mission, and remembrance for hundreds of years with hatred and vilification.

R

Blind love for a man who did not return her love led Mary to allow all her weaknesses to combine against the interests of the country she ruled. Philip was given to Mary as a husband by his father Charles V, who wanted English help in his struggle with France. Mary herself, because of her Spanish mother and passion for Spain, was delighted to marry the future King of Spain, and found herself unable to refuse his requests for English support in the fighting against France—despite the fact that such a war was meaningless and even utterly opposed to English interests. Her English subjects had their annoyance and bitterness aroused by having to pay for this pointless war, then seeing their money frittered away to no effect, and finally seeing the French overrun Calais—the last English possession on the Continent. Mary had not only involved England in a foolish adventure, but had humbled its pride as well.

It is interesting to see what people think of Mary Tudor today. It is becoming increasingly more difficult, I think, to understand people who lived in an age when religion was more central to their lives than is common today. Mary was certainly a bigoted Catholic, and because of this seems often to be considered a "good thing" by Catholics and a "bad thing" by Protestants. Perhaps we should be able to see beyond the confines of such viewpoints now.

You have seen that on the whole I am fairly sympathetic to Mary. I think the suffering she caused by her intolerance and bigotry was bad. I think in fact that it is impossible to defend the causing of pain or suffering by claiming that it is done in a "good" cause. If it is claimed that it is sometimes essential that certain pain and suffering must be caused to achieve a "good" result, then I think that either the result aimed for is not really good, or, if it seems to be, then we should spend out efforts on reorganizing things so that pain and suffering need not be caused in achieving the result. That sounds all very well—and vague—in the abstract, but I mention it simply to try to indicate from what viewpoint I am writing. I express it in this vague way because I do not want to describe it by a simple label. Labels, like "liberal humanitarian", "conservative", "radical", etc., are really meaningless, unless related to something very specific, and used between people who know what each other means by the label.

I tend to be sympathetic towards Mary because when I think about her preconceptions (i.e. the things that she accepted as ultimately true and right) I feel that they are understandable after her upbringing, and in the circumstances in which she found herself. Thus, allowing for these things, I tend to look at the human being underneath them and ask—"Given such a view of the world, and accepting such preconceptions, how did she behave?" It seems to me that Mary displayed a lot of admirable qualities. She bore suffering with considerable courage—and she certainly had more than her share of suffering. Despite her terrible childhood, so full of emotional torture, she was not wholly embittered by it and that, I think, must have taken a lot of strength of character.

Because of her preconceptions, about the rightness of Catholicism and the fact that the only way to save people's souls was to burn heretics, she used her admirable qualities towards bad ends. But as with a tyrant who, when cornered himself, fights gallantly to the last, one cannot but admire her courage, her energy and strength of character. These are occasionally "virtues" which are evident in people we describe as "mad"—as people describe Hitler as mad for example—but I don't think Mary drew her energy from madness, though it seems undeniable that she was emotionally immature—which is hardly surprising after what she had to go through in childhood and adolescence.

APPENDIX B

PRESENTATION BOOKLETS

1. History
2. Botany
3. Economics

Pages of booklets are designated by increased spacings between paragraphs.

APPENDIX B

History

The tragic life and reign of Mary Tudor. A "tragedy" can be defined as the destruction or failure of a sympathetic character because of one weakness. In this sense Mary's reign, and indeed her whole life, can be viewed as a tragedy. Her "weakness" (in the dramatic sense; she certainly considered it her strength and consolation in reality) was Catholicism, tinged as it was for her with loyalty to Spain.

Her youth was filled with memories of her father, Henry VIII, trying to get a divorce from her mother, Catherine of Aragon, in order that he might marry the young Anne Boleyn, with whom he was infatuated. Thereafter she watched the destruction of the religion she loved and had taken solace from. Later she had to suffer the horror of being declared illegitimate so that her half-brother, Edward, should succeed to the throne rather than she.

But after it all, even after the gallop towards Protestantism of Edward's reign, she did inherit the throne. She became Queen, with all the powers of the English monarchy in her control. She was no weakling; she had courage and had determined how she would use the power that fell at last into her hands. The problems were clear to her mind, and she tackled them with strength and vigour. Yet, somehow, like everything in her sad life, nothing went right.

One of the words which seems to sum up so much of Mary Tudor's reign is "irony". She was courageous, intelligent, and—in all but religious matters—a merciful and generous woman. But her religious intolerance and the foreign policy she insisted on pursuing, despite the advice of her Council and Parliament, brought about one of the most dangerous rebellions of the century, hatred for the Church she loved and for herself, and the failure of all her hopes.

Female, Catholic and Spanish. Mary Tudor was the first woman to have undisputed rule over England. Previously Matilda, in the twelfth century, had been the only woman to lay claim to the throne, and her "reign" had been spent in continual fighting with her cousin Stephen. That period of history was remembered as "The Anarchy", and, associating the rule of a woman with fighting and chaos, it was with some foreboding that men in the mid-sixteenth century looked forward to the rule of another woman.

Mary was the daughter of Catherine of Aragon and was proud of her Spanish ancestry. She was also proud of her Catholicism, and passionately devoted to the idea—which she seems to have considered a "vocation"—of returning England to the flock of the papal shepherd. She came to the English throne at a critical moment in the struggle between the Habsburg and Valois houses, and Mary's Spanish preference was a decisive factor in committing England to a further fruitless and damaging part in the battle between the great powers of Europe.The alliance which she formed with the Emperor Charles V, cemented by her marriage to his son, who was to become Philip II of Spain, was perhaps appropriate, as her father and mother had been married to cement Henry VII's alliance with a Spanish monarch half a century earlier.

Patriotic Englishmen were worried that such an alliance would simply reduce England to a Spanish colony, and they were to see their fears proved justified by the events of the next few years. Almost every member of her large and unwieldy Council opposed Mary's marriage, and it was only by showing that she had inherited not just the Tudor intelligence, but also their ferocious will and violent temper that she managed to threaten and persuade them all, one by one in private meetings, to accept her wishes.

Stephen Gardiner, for so long near the centre of power yet never given the positions that his talents warranted, found himself at last as the Queen's chief minister and Chancellor of England—having been released from the Tower to take up his new honours. He had spent many years out of office because of his Catholic beliefs, and also because Henry VIII never really liked or trusted him. Henry had found his gruff, outspoken manner, which too often verged on the border of boorishness and rudeness, not at all congenial. His Catholicism had earned him a place in the Tower during the rule of Northumberland and now, ironically, at last in power, he found his time and energy being spent on restraining a monarch who was a more radical and passionate Catholic than himself. While by no means renowned for diplomacy himself, at least he was able to see that his new sovereign's attempt to drag England headlong back to Catholicism would have to be handled with a delicacy and caution which Mary only too clearly lacked.

Opposition. Another of the ironies of Mary's reign was the fact that she inherited the title of Supreme Head of the Church, and she was to find that in England the statute law of Parliament seemed to count for more than her view of God's law; and the Parliament who gave her father the title refused to remove if from her. Gardiner prevented her simply declaring all Henry's and Edward's religious legislation null and void, and managed thereby to avoid possible rebellion. While religious feeling might not have been the well-spring of such revolt, the dedication of so many lords and gentry to their Church lands and property easily could have been.

The first Parliament of her reign quickly showed the tenor of feeling about the issues which faced the country. It was made very clear that while a return to Catholic doctrine could be won easily, there was to be no return of Church lands. Parliament, whose confidence and power seems to have been greatly increased by being the instrument of the Reformation in the 1530s, and so being one of the anchors of the governments during Edward's reign, sent a complaint to Mary about her proposed marriage to Philip. Mary's reaction was simply to push ahead with the marriage, which was celebrated by proxy in October of 1553.

Mary's mercifulness prevented large-scale executions for the plot hatched by Northumberland to deprive her of the throne. Only three died for that treason. Her concern was not with the laws of England but with the laws of God, as she saw them. During the first months of 1554, however, one of the most dangerous revolts of the century took place. It was not the biggest or most widespread, but it was led with determination, and clarity of purpose, and it took place close to London. Sir Thomas Wyatt led 3,000 men of Kent on the capital. Finding London Bridge defended, the group passed up river and crossed the Thames at Kingston, and from there marched on the city. Wyatt and his followers were motivated by opposition to Catholicism, and a resentment against the Spanish marriage which they felt would be disastrous for England. The rebel forces got right to the walls of the city, and were only overcome with difficulty in confused street fighting centred on Fleet Street.

Mary was again reluctant to allow executions to follow for mere acts of treason, but the counsels of Gardiner and the powerful though distant voice of her father-in-law, the Emperor Charles V, prevailed. Wyatt and many followers were executed in London and Kent. The lovely and innocent Lady Jane Grey and her husband, Northumberland's son, were sent to the scaffold as well. Mary's young sister Elizabeth, in whose name Wyatt led his rebellion, was perhaps fortunate not to find herself on a scaffold with her champion. The result of the revolt was the opposite of what was intended. Instead of overthrowing Mary, it made people realize that the danger of anarchy was still very real, and so support for her and, reluctantly perhaps, her policies was reinforced.

Mary was 37 years old on her marriage to Philip, and her hope to keep England faithful to the Church of Rome (once she had reestablished England's obedience to the Pope and the Pope's forgiveness of the stray sheep) rested on her providing an heir to the throne. If she died without a child, her sister Elizabeth would succeed, and Elizabeth's religious feelings were most suspect. In July 1554, Philip at last arrived in person, and the marriage was celebrated to less than warm rejoicing throughout the country. But Mary was, for a while, happy. She loved her husband, and seemed unaware that he did not love her in return.

The imposition of catholicism. Mary's constant preoccupation was the return of her country to Catholicism. By her authority as Supreme Head of the Church—a power she felt was contrary to the laws of God—she had reversed the religious advances of Edward's reign. She had also ejected thousands of clergy for heretical opinions, and for taking wives. The more advanced and powerful Protestants had been removed from their bishopries and mercifully given time to flee to the Continent, which large numbers did. They went to centres of the Continental Protestant Reformation, and there learned more extreme doctrines and gathered a new and passionate enthusiasm, which they were to bring back to England after Mary's death. Others, however, stayed and were to form the core of the most prominent Protestant martyrs of the reign. Cranmer himself was in the Tower charged with treason. Hooper, Ridley and Latimer also stayed to face whatever was to come.

Cardinal Reginald Pole was made the Pope's Legate, committed with the task of returning England to the body of Christendom. Pole, himself English and related to the royal house, was perhaps as bad a choice for this delicate job as could have been found. Like Mary he was personally kind and merciful, but also like Mary he was a religious fanatic. He was unwilling to accept any compromise and it was only after the greatest efforts by Charles V and the more realistic English ministers, including Gardiner, that Pole accepted that there would be no return of Church lands before England could be received back into the Roman fold. In November 1554 Pole reached England, and Parliament showed its repentance by repealing all the anti-papal legislation passed since 1529, and on its knees received the Pope's forgiveness.

Mary and Cardinal Pole were determined to obliterate the last vestige of heresy in England, and **thought the best method to achieve this end was by** force. They felt that only by such means—by destroying the bodies—would it be possible to save English souls, and they also thought it would only need a few burnings to bring the rest of the Protestants cowering back to the Roman Church. So, early in 1555 the heresy trials began. Most of the 300 victims of Mary's religious fanaticism were from the lower classes. Hardly any gentry or nobles, who were not also clerics, found their way to a martyr's death. Cranmer, Ridley, Latimer and Hooper provided the most prominent Protestant martyrs and, as Latimer predicted to Ridley while the flames enveloped them, the torch that was lit there was to spread across England.

Mary had done the unforgiveable. England was used to seeing the law employed in the disposing of men who were a danger to the throne. Even men like Thomas More could be executed by the Crown and there would be little disturbance, because a quick and violent death was one of the risks attached to being close to power and wealth in these times.

Order was always on a delicate balance, and royal power was the guarantee of that order. If any man threatened that power, he threatened the stability of the country, and for such a threat the penalty was death. But Mary was not playing according to the accepted rules. She was burning ordinary commoners who were no threat to her throne, for their religious opinions. It was just what so many had most feared. Even though Philip tried to restrain his wife and Cardinal Pole in their zeal, English people had indelibly drawn on their mind the fact that such cruelty was typical of foreign, Spanish, practice. It was not English. Spain and "Catholic" were beginning to be associated in English minds too, and Mary, in giving the Protestant Church its 300 martyrs, was laying a firm foundation for the loyalty to Protestantism and the deep antagonism to Catholicism which was to be typical of England for centuries.

Towards a bitter end. Late in 1555 Stephen Gardiner died, having understood the futility of the burning of heretics. By his death one of the few restraining influences on Mary was removed. Mary's tragic life had still three years to run. Her husband Philip had left her to go and take over his inheritance, Spain. There was no child to inherit the throne. And things got worse.

Pope Paul IV quarrelled with Philip, excommunicating him, and later quarrelled with Pole, depriving him of his position as Papal Legate in England. Such distress to Mary was aggravated further in 1557 when the war between Spain and France was renewed. Philip returned to England to persuade his still infatuated Queen to lend her country's help to his cause. Overriding all objections from her Council, Mary continued to fulfil the worst fears of her subjects. Without any reason, from an English point of view, war was declared with France and desperate and illegal measures were resorted to in raising the money to pay for the absurd adventure. Englishmen saw their country used to further Spain's interests and worst of all, they saw their country sacrificing its own interests for Spanish ones. Early in 1558 England's last possession on the Continent, Calais, was overrun by the French. Since the decline of the wool trade which passed through Calais, that foothold on the Continent had been merely an expensive burden, not in any way repaying the cost of its upkeep and defence, except in prestige and pride. With the loss of Calais, it was English prestige and pride that were broken, and all the resulting anger and bitterness was turned on Mary.

All these disappointments in the things she most wanted broke her heart. The child she was still desperately, almost hysterically, hoping for was not to come, and it was clear to all that soon England would have a new Queen. Mary died in November 1558, and her ally Cardinal Pole died within hours. The return to Catholicism died with them, and England waited in doubt and not a little fear to see what the reign of the fifth Tudor would bring.

Botany

About the nearest approach to utter simplicity that we can find in living organisms appears in a small and decidedly inconspicuous group of plants known as the ***blue-green algae.*** From this group we have selected about the simplest of all, a unicellular form belonging to the genus *Glococapsa.* The body of a single *Glococapsa* plant is far too small to be seen by the naked eye; we must examine it under the high power of the microscope to get any adequate idea of its structure. When we look at it in this way, we see a tiny, nearly spherical body, consisting of a wall inclosing a mass of granular material. Actually this material, which looks granular, is of a jelly-like consistency and is nothing more or less than *protoplasm,* the essential living substance, the truly living part of the body of every plant and animal. But the protoplasm that we see in the body of *Glococapsa* should be thought of not merely as a certain amount of the living substance but as being organized into a definite unit which we call the ***cell.***

The surrounding wall, which is merely a lifeless product of the protoplasm itself, has its function in maintaining the shape and providing protection for the living substance within. The type of wall that we see is a feature that serves fairly well to distinguish plants from animals. The organized protoplasm of plant cells (but not of animal cells) is inclosed by cell walls composed exclusively, or in the main, of ***cellulose.***

Probably no concepts have been more significant and fruitful in the development of biology than those that are included in the so-called "cell principle." Robert Hook in 1665 observed the units of structure in cork, and, since these tiny structures reminded him so much of the cells in a penitentiary, he gave them that name. Later, in 1838, Schleiden observed that plants were composed entirely of cells, and the following year Schwann made the same pronouncement for animals.

The expression "cell principle" includes two component concepts: (1) that the bodies of all plants and animals are composed of cells, and (2) that new cells are derived only by the division of pre-existing cells.

The higher plants and animals, such as ourselves, have multicellular bodies, with sometimes as many as several billion cells structurally and functionally co-ordinated in the body of a single individual. Cells of higher plants vary between 1/250 and 1/2,500 inch in diameter, while some of the very smallest cells of bacteria may be only 1/25,000 inch in diameter. It has been estimated that a single mature leaf of an apple tree contains 50,000,000 cells. If we multiply this figure by 6,000—the approximate number of leaves on an average-size apple tree—we can arrive at a figure for the total number of cells in the leaves, but this does not include the cells in the fruits, stems, and roots. Many of the simpler plants and animals, however, have bodies that are unicellular. *Glococapsa* falls into this category, for the entire individual consists of only one cell. This, then, is one reason for regarding *Glococapsa* as perhaps our simplest plant; but this reason alone would not suffice, for there are actually many thousands of plants and animals which are one-celled bodies.

Glococapsa is bluish-green in color; this is the effect of two soluble pigments, a blue pigment called *phycocyanin* and a green one, *chlorophyll*, which suffuse the protoplasm. The blue pigment is a comparative rarity in the plant kingdom, appearing in the blue-green algae and but rarely in the red algae. Its function is not well understood, but it may facilitate the manufacture of food in these algae under the limited light conditions in which they usually live. Chlorophyll, however, is as famous as any substance in the biological world. Present in all green plants, it has the remarkable power of enabling the plant to manufacture food out of materials which themselves possess no food value. Chlorophyll bears a remarkable similarity to hemoglobin, in the blood of animals. A plant that is *chlorotic*, that is, losing its green color and becoming yellowish, may have its color rapidly restored by supplying it with iron. Similarly, when a human becomes anemic because his hemoglobin percentage is low, the administration of iron often stimulates the production of hemoglobin and restores color to the blood.

Green plants are independent organisms, for they are capable of maintaining themselves in the absence of other forms of life. Here we

see a second reason for regarding *Gloeocapsa* as primitive; the earliest organisms must have been independent. They could not have parasitized something which did not exist. Once again, however, the criterion is not decisive, since this same independence is characteristic of most of the members of the plant kingdom.

In nature, *Gloeocapsa* lives at the bottom of shallow pools of fresh water. Some of this water diffuses through the cell wall into the protoplasm, along with a certain amount of carbon dioxide, which is dissolved in the water. Out of these two simple raw materials, the energy supplied by sunlight, and by virtue of its possession of the green chlorophyll, the protoplasm manufactures food for itself.

Living protoplasm is a going concern, always in a dynamic state. It is constantly in motion, carrying the granules and cellular inclusions to various portions of the cell. As we shall see later and as can be demonstrated in the laboratory, the chloroplasts in the cells of higher plants are circulated within the cell by the streaming protoplasm so as to place each plastid for a time in the most favorable light position. Like a running motor, the cell demands a continuous supply of fuel. Otherwise it will stop running, and death will occur. For fuel the living organism can make use of only a limited class of substances—substances which not only contain energy but contain it in a form that can be released and put to work by the organism. This is the category of substances that we refer to as *food*. *Glococapsa* manufactures its own food and consumes the larger part of it as fuel to keep its protoplasm alive.

Some food is stored up against a future need. If this were not the case, the plant would probably die under those conditions (notably lack of sunlight) which prohibited food manufacture. Among the higher plants, special storage depots are usually present. Most plants store their excess foods in the form of carbohydrates; animals store mostly fats. *Glococapsa*, however, can do no better than to store a certain amount of food rather diffusely through its protoplasm, since it has no specialized tissues.

A portion of the manufactured food is devoted to growth. Displaying the power which more strikingly than any other distinguishes the living from the non-living, *Glococapsa* converts part of the food into additional protoplasm. Protoplasm, of course, is a very complex substance made up of carbohydrates, fats, proteins, minerals, and other

compounds. Its production involves not merely transformation of the food but also the addition of certain other chemical elements that are available in the surrounding medium. The resulting growth appears as an increase in the size of the *Glococapsa* cell, with a gradual stretching of its rather elastic wall and the production of new wall substance by the protoplasm. Growth must also include repair. In many-celled organisms some cells of the body are frequently lost, either by accident or in the course of the ordinary life processes. Repair may be thought of as involving the same fundamental transformations of food as occur in connection with growth. Growth, however, brings an increase in the size of the body, which is not the case in repair. In a single-celled organism such as *Glococapsa* the phenomenon of repair should doubtless be admitted as a hypothetical proposition, but it would be difficult to demonstrate in such a simple plant.

In the main features of food manufacture and food use, *Gloeocapsa* does no more or less than any green plant. Its uniqueness lies in the fact that it accomplishes all this with a cell that is exceptionally simple. The protoplasm of *Glococapsa* is homogeneous; all parts of the protoplasm appear to be the same, and apparently all parts engage in the various life activities. It is this simple, undifferentiated protoplasm that provides our third reason, and our best reason, for regarding *Glococapsa* as one of our simplest plants.

The fourth reason appears in connection with its reproduction. Under favorable conditions *Gloeocapsa* continues to grow rather steadily. When the cell has reached a certain size, it simply pinches in two in the middle to form two small "daughter cells." These daughters round out into separate spheroid cells, each with its own elastic wall, and the two remain together, along with the rest of the plant's cells, within the common outer plant wall.

This is the simplest conceivable type of cell division, and we speak of it as *reproduction by fission*. Two individuals now exist where before there was but one. Reproduction could be no simpler than this so that there we have reason No. 4 for regarding *Glococapsa* as representing the extreme of simplicity.

The two new individuals proceed to carry out their lives quite independently of each other. Later they reproduce according to the same simple program—probably not much later, for in such simple forms the "life cycle" (i.e., the sequence of events that attends from a given stage in one generation to the corresponding stage in the next) is very brief. Under highly favorable environmental conditions, one generation in some of the blue-green algae may be consummated in less than one hour's time. Perhaps we should cite this feature, too, as a criterion of primitiveness for *Glococapsa*. Certainly it is a prevalent condition in simple organisms, while the more complex bodies of higher forms must pass through quite a succession of stages before they become mature and capable of reproducing.

In the higher plants special reproductive organs are differentiated from the vegetative body, but in a blue-green alga, with its single-celled body, no such differentiation is possible. Here reproduction is accomplished by simple division of the vegetative body itself. We refer to the main body of any plant—the part that carries on the ordinary life processes, or "vegetative" processes—as the "vegetative body." The term is as applicable to a one-celled plant as it is to the higher forms. Thus we say that reproduction of *Glococapsa* is by *vegetative multiplication*, as reproduction by fission is called in plants.

In this connection the point should be made that *Glococapsa* is primitive not simply because it reproduces by vegetative multiplication but because this is the only mode of reproduction it possesses. Actually, many of the higher plants, while introducing new and more specialized methods of reproduction, retain as well the power of vegetative multiplication, so that at times they produce new individuals through separation from the parent body of groups of cells which appear to be ordinary vegetative cells.

One of the characteristics of blue-green algae as a group is the production of *mucilaginous sheaths. Glococapsa* is no exception, for apparently the outer part of its cell wall becomes changed (through some action of the surrounding water or by an accumulation of metabolic waste products) into a transparent covering. Commonly, two daughter cells will remain side by side, stuck in the matrix which is provided by the old mucilaginous sheath of the "parent," and often the old sheath persists to hold four "granddaughters" together. The two or four cells so associated are, however, mutually independent, so that we refer to such a formation as a "colony" rather than as a many-celled individual. If any agency breaks up the colony, the individuals will apparently live when separated quite as successfully as they had lived side by side (Fig. 1).

Although most blue-greens share with *Gloeocapsa* the several features of simplicity that we have described, the form of colony produced by others is somewhat more complex. Very often thousands of individual cells are stuck together in a transparent mucilaginous matrix which represents the combined output of all of them. In nature, therefore, the blue-greens are most commonly encountered in the form of slimy masses (spheroid or amorphous) growing in shallow fresh water or upon damp rocks. Some, however, grow in salt water and some on damp soil and the moist bark of trees. One of the members of this group is responsible for the characteristic color of the Red Sea—showing that "blue-green" algae may sometimes contain a conspicuous red pigment, *phycoerythrin*, as well. They grow successfully in hot springs at a temperature far beyond that which most other plants could endure. Around the hot springs and geysers of Yellowstone National Park there are so-called sinter deposits, and in connection with these there is a plentiful growth of blue-green algae. These forms are

able to resist not only great heat but also extreme cold. They can also tolerate great dryness and strongly alkaline water. Altogether, the resistance of this group exceeds that of all other plant groups, save only the bacteria. The relation between their universality of distribution and their high resistance is an obvious one. How these two characteristics are related to the simplicity and antiquity of the group provides an interesting field of speculation.

The closest relatives of blue-green algae are apparently the bacteria, with resemblances which impel most biologists to place the latter in the plant kingdom. Aside from this, it is difficult to place the bacteria, for the group displays a mixture of plantlike and animal-like characteristics. Like the blue-green algae, the bacteria have single-celled bodies and undifferentiated protoplasm; like the blue-greens, they reproduce by simple cell division (vegetative multiplication), multiplying very rapidly under favorable conditions; and, like the blue-greens, many of them have extraordinary powers of resistance. In truth, bacteria excel blue-greens in this respect; in the spore stage some are able to survive in boiling water for several hours.

The big difference lies in the fact that most bacteria lack chlorophyll and cannot manufacture their own food. Hence they are usually "dependent," directly or indirectly, upon other living organisms. The combination of dependency, ubiquity, high resistance, rapid multiplication, and microscopic (or even ultra-microscopic) size makes this group the great disease-producer among man and other organisms. For this and other reasons bacteria are of tremendous economic importance, and in recognition of this importance most universities now maintain distinct departments of bacteriology. We shall return to bacteria in chapter 10, in a context that will bring out more clearly the significant roles that they play in the organic world.

Economics

PRESENTATION

The cloth trade. Throughout the Middle Ages the main English export had been wool. English wool was the best in Europe and had been highly prized on the Continent, where it had formed the raw material for the great cloth industries of Flanders and Northern Italy. But during the century and a half before Henry VII came to the throne, England had been developing a cloth industry of its own. By Henry VIII's reign, the English carried about ten times more cloth than raw wool in the great twice or thrice yearly shipments to the fairs in and around Antwerp.

The cloth was sold in lengths - officially 24 yards long, but often quite a bit longer. There was really little standardization despite official attempts to impose it. Besides the woollen cloth which made up the bulk of the exports, there were a variety of other different sorts and qualities of cloth; light kerseys, coarse "dozens", friezes, and the northern "cottons" which were much cheaper materials.

The growth of the cloth trade throughout the first half of the sixteenth century was steady and, until the boom following the debasement of the coinage, which we will consider later, just short of spectacular. Early in Henry VII's reign about 50,000 lengths of cloth were exported per year. By the last years of Henry VIII's reign about 120,000 were taken over to Antwerp, and even more were sold during the boom years.

To feed this cloth industry, it has been estimated there were three sheep to every person in England. The trade in cloth was an easy and profitable one and consequently it grew steadily, until the whole economy was heavily dependent on the sheep. A large proportion of the population relied on the state of the wool and cloth trade for their livelihood: from shepherds to those involved in the cloth industry, from cloth-dealers to the Merchant Adventurers.

The wool travelled from the backs of the sheep to be made up into cloth by either workshops in the towns controlled by the gilds, or, as was more and more frequently the case, by individual workers in the country outside the gild restrictions. Those outside the towns and gild control were able to work with just the needs of the markets in mind. The gilds tried to ensure that the cloths made up by their workers were then 'finished' (dyed and made up into articles of clothing) by other members who were traditionally involved in 'finishing' processes. The trouble was that foreigners had little respect for English 'finishing' and much preferred to buy raw cloth. Thus the country workers found that the cloth-dealers who bought up cloths around the country for delivery to Blackwell Hall - the Merchant Adventurers' headquarters in London - preferred to buy from them, because they were not restricted by gild regulations and were quite happy to produce unfinished cloths.

The government too tried to ensure that English 'finishers' should work on English cloths before they were taken abroad, and laws were passed at regular intervals to prevent too big a proportion of unfinished cloths being exported. The merchants, who knew what their markets wanted, simply ignored the legislation.

From Blackwell Hall the cloths would be carried across the North Sea by the Merchant Adventurers, or by men they hired, and taken to the fairs around Antwerp. There they would be laid out on specific days and buyers from all over Europe would come to look them over. The wool which started on the back of an English sheep might finish up on the back of almost anyone in Europe.

Profits were good for the Merchant Adventurers. Their money was made on the sale of their cloths abroad. They made little on the goods they sometimes bought in Antwerp and re-sold in England. During the 1520's and 1530's the average profit seems to have worked out at between 15 and 25 per cent. This meant that a man could expect to double his money in four or five years.

All this growing prosperity, however, was precariously based. It depended almost entirely on the sale of a single commodity - cloth - in a single market, and if anything went wrong with that market, or with the commodity, the whole economy would be in trouble. This is just what happened.

The trade might have continued in its dull, routine and profitable way had it not been for the dramatic effects of the rise in prices which was being felt all over Europe, and Henry VIII's debasements of the currency which brought the English economy to the brink of chaos.

The company and politics. A "Merchant Adventurer" was one who traded with foreign parts. The Company of Merchant Adventurers, formed half way through the reign of Henry VII, consisted of those men who controlled the cloth trade. Their aim in forming the Company was to ensure that no merchant not belonging to their Company should get any of the profits from trading in cloth. They tried to keep out other merchants by fixing the fee for membership so high that none of the less wealthy merchants from ports outside London (known as "outports") could afford to pay it.

Henry VII had to intervene and reduce the fee, but in so doing he acknowleged the right of the Company to charge one. There was some justification for a reasonable fee, because the Company had to pay for the upkeep of various offices and centres in London and others in Antwerp (London dominated the cloth trade, as it dominated all foreign trade by this time. All the other ports together handled only about 1/10 as much trade as London.). As well as the Company's need to finance various offices, it was absolutely necessary to have a strong organization to back up commercial ventures at that time. The individual merchant stood little chance of surviving against the trading organizations - like the German Hanseatic League in the Baltic, or the Venetians in the Mediterranean - and a trader putting into a port which a trading organization felt was "theirs" might find himself negotiating

by cannon.

The Merchant Adventurers were not a Company in the sense we tend to understand the word. They were unlike the joint-stock companies (of whose development we will see the beginnings) in that they traded individually. They did not pool their resources, except on occasions when they hired protective ships when there was danger from pirates. They bought individually from sources they found for themselves, and they negotiated their buying prices separately. Once across in Antwerp they sold their cloths separately, and decided for themselves whether or not to invest the money they made i other goods which they could import into England and sell when they got back.

At the end of the fifteenth and beginning of the sixteenth centuries everything seemed to be going well for the Merchant Adventurers. In 1496 Henry VII had negotiated a favourable trade treaty, the "Intercursus Magnus", with the Archduke Philip of Flanders, which was to benefit the Company enormously.

A further advantage the Merchant Adventurers enjoyed during Henry VII's reign was the smallness of the customs tax on cloth. During the Middle Ages Kings had continually increased the tax on wool, till by 1485 the tax amounted to about one-third of the value of the wool itself, whereas cloth which was a relative newcomer to the customs was taxed a barely noticeable 3 per cent.

The price rise and debasements. During the first decades of the sixteenth century England experienced a gradual price rise. The price of goods depends on the relationship between money available and goods available. If there is not much money but plenty of goods prices are low. If there is a lot of money but not many goods prices are high. The causes of the sixteenth century price rise, like any large scale economic event, are very complex and even now not fully understood. One clear cause, however, is traceable. That was the influx of silver to Spain from her newly-won territories in the Americas. There was no increase in the production of goods in Spain, so the increased amount of money available led to an inevitable rise in prices.

This situation made trading with Spain very profitable. During the 1520's the rise in prices was affecting Spain before other countries, so an English merchant could buy goods cheap in England and sell them at the higher price normal by then in Spain. Thus the English merchant made his normal profit and also the difference between prices in Spain and England.

Because of the heavy trade between Flanders and Spain it was not long before the price rise hit Flanders. The supply of money increased in relation to the supply of goods because the Flanders merchants took goods to Spain and brought their profits home. The increased output of the German silver mines had the same effect. Again the English merchants stood in a position of advantage. As the price rise in England was still less rapid than in Flanders, the English merchants could continue to buy goods relatively cheaply in England and sell them for the higher prices prevailing in Flanders.

This state of affairs continued throughout the 1530's when, despite some early trouble with the Emperor, Charles V, ruler of Flanders the Merchant Adventurers enjoyed smooth and profitable business. They were helped by the encouragement and policies of Thomas Cromwell,who himself had been a merchant and had close connections with the Adventurers. The growing prosperity and wealth of the English merchants, and most of those connected with cloth and wool, began to drive English prices up ever more rapidly - to the consternation of those who were gaining no profits to compensate for the increases in prices.

After the execution of Thomas Cromwell in 1542, Henry VIII took upon himself the responsibility for guiding the policies of his realm. The economic policies he pursued were short-sighted and disastrous. Involving himself in costly wars, he quickly exhausted the fortune Cromwell had made available to him, and so adopted the plan of debasing the coinage. He reduced the amount of silver in the coins, keeping the silver thus saved in his Treasury. Since the coins were now worth less, more had to be given than before for the same amount of goods.With the

demand for the goods on the market steadily increasing as the merchants bought more for shipment overseas, prices rose dramatically, causing confusion and havoc throughout the country.

One immediate result of the debasements however was that the Merchant Adventurers gained enormously. In 1522, the £ English was worth 32/- Flemish, but by 1551 after the devaluations it was worth only 13/4d. This meant that if an English merchant paid £1 for goods in England he would, in 1522, have asked 32/-(plus his profit) for them in Antwerp, whereas in 1551 he asked only 13/4d(plus his profit). So while the debasement hit English domestic trade, they made exporting much easier since the dealers at Antwerp were able to buy the same goods at half the 1522 price.

Because of the cheapness in their selling price, English merchants found they could sell as much cloth as they could carry, and there were complaints from abroad that short sizes and inferior cloth were being sold: an indication that English merchants were taking across everything they could lay their hands on, sure of a ready market.

But in 1551, after social unrest and riots, the Government took steps to reform the value of the English coinage. Once this had been done it became much more difficult for the merchants to sell their goods because the earlier situation was now reversed. During the boom years the merchants had encouraged the expansion of the cloth industry, and it had responded by increasing its output enormously - only to discover in 1551 and the following years that there was suddenly no market for the increased output. Producers were angry, many independent cloth makers ruined, and even the merchants, finding themselves with more cloth than they could sell in the normal markets of Antwerp, were desperate to find new outlets.

The diversification of trading efforts. Largely because of this crisis, we see in the 1550's the first really adventurous voyages from London in any quantity. The ease and ensured profits of the London-Antwerp trade made the London-based Merchant Adventurers reluctant to try further abroad. Earlier adventurous trading voyages like those of the Bristol merchants to Newfoundland, or Plymouth merchants to South America, were nearly all undertaken by 'outport' merchants who were excluded from the cloth trade to the continent by the self-protective policies of the Merchant Adventurers' Company.

Earlier in the century, for political reasons English merchants had been discouraged from seeking new markets around Africa to the south, and to the Americas in the west. The Tudor throne had needed the support of foreign monarchs, and so the newly found 'empires' of Spain and Portugal had been left alone. But by the 1550's relations with Spain were growing worse, despite Queen Mary's marriage to Philip II of Spain, and the need for new markets made English seamen less inclined to respect Spanish and Portuguese 'property'.

With the trade collapse after the reforming of the coinage came a spate of voyages along new routes. Much of the money to pay for these more risky adventures came from the tremendous profits made in the years between the debasements and the reforming of the coinage.

Attempting to find a passage round the north east of Europe to India, and its spice trade, English merchants found instead the great Russian Empire, and entered into trading relations with Ivan the Terrible. Contact was made with the Levant (the eastern end of the Mediterranean) where spices from Asia came through to Europe. With the weakening power of Portugal in the Indian Ocean, more of these Asian spices were finding their way overland.

Soon trade was carried on with North Africa and Guinea. Expeditions went to North America, again looking for a way to India. A new line in English trade was struck out by Hawkins, who raised money in London for expeditions to West Africa to buy slaves from native rulers. He then crossed to the West Indies or the Spanish Main, where he made large profits selling the slaves, and returned home with full holds of American goods.

Many of the expeditions of these years ended in failure, as trading also involved a possibility of fighting and the probability of becoming involved in politics. Merchants often had to negotiate rights to trade from various rulers - for which rights they might have to pay dearly. Occasionally, especially in Spanish or Portuguese possessions, merchants ran into local administrators who refused permission to trade, and so they were left with the choice of simply moving on empty-handed or fighting their way into the ports where there might be people only too ready to trade with Englishmen, or anyone, provided they carried goods that were wanted.

Protection. After the crash of 1551 and the following years, the Merchant Adventurers continually lobbied the government for protection from the economic consequences of reforming the coinage. Sir Thomas Gresham brought help in the form of a reorganization of the Merchant Adventurers' relationships with the State and with the 'Staple' town of Antwerp (the town at whose markets all the cloth was sold, in exchange for certain privileges). He gave the Company the monopoly in the export of white cloth for which they had struggled so long. But for these privileges, protected by the government well into Elizabeth's reign, the Merchant Adventurers' Company was heavily taxed - in the same way as the wool merchants during the Middle Ages. Throughout the latter part of the century the Company concentrated on consolidating the gains it had won, trying to protect their government-given rights from 'interlopers' who tried to trade with Antwerp despite the Company's monopoly. Again, over the problem of interlopers, they turned to the government demanding protection.

Later, in Elizabeth's reign, the Company introduced 'stints'. That is, they allowed only a certain amount of cloth to be exported, and by this means tried to keep prices high and preserve and protect their sure sales and profits. But while they continued their routine and, especially after the destruction of Antwerp in 1576, their slowly declining trade with the nearby continental coast, the foundations of greater things were being laid around the world.

New adventures and adventurers. The 'joint-stock' companies which were formed in London were made up by men and women risking an investment of money in expeditions to all parts of the world. On the completion of the expedition - if it were successful - the profits were shared out according to the investments made, or sometimes held over to equip a bigger expedition. By such means Hawkins and Drake found the money for their adventures. Many were just excited by the prospect of quick returns from attacks on Spanish treasure ships, or hopeful that they too might find gold and silver somewhere with the ease and in the abundance that the Spaniards had.

The step from respectable trader to buccaneer was not very great in these times. Every merchant ship would be armed, and what was permitted in English law might be illegal in Spanish. Drake's adventures made him a hero at home, and respectable enough to be knighted by the Queen herself, whereas to the Spaniards to whom he caused terror he was nothing but a pirate. Those were violent times, and while the force of law was spreading on land, there was no law on the open sea that everyone would respect. The law of the cannon ruled.

APPENDIX C

CHALLENGES AND ESSAY QUESTIONS FOR EACH STUDY UNIT

1. History

2. Botany

3. Economics

History Challenges

1. After so much hope to do good for her country when she came to the throne, Mary finished her life in bitter despair. Using the cards, construct a picture of Mary's disappointments. (Place all the cards that relate to this problem in the left bin and those that don't relate in the right bin.)

2. Previous to Mary's reign, England had intermittently aided both Spain and France in their struggle for power. England's involvement cost them dearly because neither Spain nor France was willing to pay much for England's aid. With this in mind, explain what led Mary to involve England in war with France. (Place all the cards that relate to this problem in the left bin and those that don't relate in the right bin.)

3. During Mary's early reign England became a Catholic country again. Explain why during this time, how she was able to return England to Catholicism. (Place all the cards that relate to the problem in the left bin and those that don't relate in the right bin.)

History Essay

Ss Name_____ Condition C2; C6; M2; M6; SM; S; R; Other___

Ss No._____ Position within condition_____ Passage M; E; B; Other__

Essay: Mary owed her throne to popular uprisings in her favor. The English people on the whole, welcomed her as a Tudor and as rightful sovereign. Yet within five years almost all her subjects hated her and longed for a change of rule. Explain why there was the massive swing in public opinion against Mary in so short a time.

Spend 15 minutes only!

Botany Challenges

1. How does Gloeocapsa and other blue-green algae reproduce? (Place all cards that relate to this problem in the left bin and those that don't relate in the right bin.)

2. How does the concept of independence relate to Gloeocapsa? (Place all cards that relate to this problem in the left bin and those that don't relate in the right bin.)

3. All plants and animals need food to survive. Describe how Gloeocapsa obtains and uses its food. (Place all cards that relate to this problem in the left bin and those that don't relate in the right bin.)

Botany Essay

Ss Name_____ Condition C2; C6; M2; M6; SM; S; R; Other_____

Ss No._____ Position within condition____ Passage M; E; B; Other___

Essay: List and briefly describe the major reasons for regarding Gloeocapsa as primitive.

Write for 15 minutes only!

Economics Challenges

1. **Assume that you are trying to argue that the Company was** never really adventurous. Consider what factors you would use to prove your case. If you think they really were adventurous, try nevertheless to construct an argument to prove your case. (Place all the cards that relate to the problem in the left bin and those that don't relate in the right bin.)

2. Before 1550 most of the Merchant Adventurers' dealings were only with Antwerp. After 1550 English trade expanded and English ships started to sail to ports in the Baltic, Africa, the Americas and other countries. Why was there such a sudden break out from the trading with Antwerp that was practiced earlier? (Place all the cards that relate to the problem in the left bin and those that don't relate in the right bin.)

3. During the first half of the sixteenth century, the Merchant Adventurers' Company became one of the most powerful and influential groups in England. Consider why this Company and its members should have achieved such a position. Why did it all happen? (Place all the cards that relate to the problem in the left bin and those that don't relate in the right bin.)

Economics Essay

Ss Name_____ Condition C2; C6; M2; M6; SM; S; R; Other_____

Ss No._____ Position within condition_____ Passage M; E; B; Other___

Essay: The late 1540's mark the high point of the Merchant Adventurers' profits, and the trade turnover never again came up to the level of those boom years. Explain why their fortunes declined during the latter half of the century.

Spend 15 minutes only!

APPENDIX D

EXPERIMENTAL INSTRUCTIONS

1. Instructions for Mandler Sorting Groups C-2, C-6, M-2, M-6
2. Instructions for Group SM
3. Instructions for Group S
4. Instructions for Group R
5. Instructions for Group R-2

Instructions for Groups C-2, C-6, M-2, M-6

You see before you 3 decks of computer cards with sentences printed on them, a sheet of paper with 30 spaces, and a box with (2 or 6) bins. All decks contain the same sentences but in a different order.

Your task in this experiment is to place the sentences of a given deck into (2 or 6) meaningful piles. You will begin by sorting the first deck (on your far left) into piles. You will then sort the second deck containing the same sentences arranged in a different order. Again, you should try to sort them into similar meaningful piles. Now, in sorting the third deck (which contains the same sentences as the other decks), I want you to place the cards into the same bins (piles) as you did when you sorted the second deck. This will be easier, of course, if you have formed a good organization when you sorted the first two decks. In sorting, please put together sentences that seem to <u>you</u> to belong together in terms of their meaning. Do not base your sorting on silly things like the first word, or number of words in the sentence, etc. Outside of this request, you may use any rule or criterion you wish to place the cards in the bins. After you have sorted the 3rd deck, you will be asked to write down on the sheet of paper all the sentences you can remember in any order you wish. To be good at remembering, you must <u>read</u> the cards carefully when you are sorting them.

Specific Instructions

You will be keeping the time it takes you to sort each of the decks. When I tell you to begin, look up at the clock and write down your starting time on the <u>back</u> of the paper with 30 spaces on it. Then pick up the deck on your far left and turn it over. Look at the first sentence, and place it in one of the bins in front of you with the sentence facing you. Then look at the next sentence. If this sentence is related to the first, place it in the same bin so that it covers the first sentence. If it is not related to the first card, place it in another bin and start a new pile. Continue until you have sorted all the cards in the first deck into the (2 or 6) bins. You should only be able to see the top card on each pile, and once you have laid a card down you may not move it to another pile. Immediately after you have finished sorting, look up at the clock and write down your finishing time for the first deck. THEN RAISE YOUR HAND. I will then come and pick up the cards you have sorted. Before you sort the 2nd deck, be sure to look up at the clock and write down your starting time. When you sort the 2nd deck, sort into (2 or 6) meaningful piles similar to the ones you formed on the first deck. When you sort the 3rd deck, try to sort the cards into the <u>same</u> (2 or 6) bins you did on the second deck.

Remember that you are going to be asked to write down the sentences **after you have finished the third deck.** So <u>read</u> the cards as you are sorting them. Spend 15 minutes, writing down the sentences. Time yourself and when 15 minutes has passed raise your hand. I will then give you a short answer essay question to write on for 15 minutes. After 15 minutes has passed raise your hand. The experiment will then be over!

Remember, when sorting any deck:

First: Write down your starting time.

Second: Sort the deck into (2 or 6) meaningful piles.

Third: Look up at the clock and write down your ending time.

Fourth: Raise your hand.

Never shuffle through a pile to see what cards you have been placing in it.

Do not worry about what your neighbors are doing. They are doing something different from you, and it may take them either more or less time to complete their task than it will take you to complete yours.

Happy sorting!

Instructions for Group SM

You see before you 3 decks of computer cards with sentences typed on them, a sheet of paper with 30 spaces, and a box with two bins. All decks contain the same sentences but in a different order.

Your task in this experiment is to sort those cards that relate to the problem I will give you. Those sentences which seem to you to help you solve the problem, place into the bin on your left. Those sentences that do not seem to help, place in the right bin. Each time you sort one of the other decks you will be given a new problem to solve. Be sure always to place the sentences that relate to the problem in the left bin and place the others into the right bin. After you have sorted the 3rd deck, you will be asked to write down on the sheet of paper all the sentences you can remember in any order you wish. To be good at remembering, you must read the cards carefully when you are sorting them.

Specific Instructions

You will be keeping the time it takes you to sort each of the decks. When I tell you to begin, look up at the clock and write down your starting time on the back of the paper with 30 spaces on it. Then pick up the deck on your far left and turn it over. Look at the first sentence. If it is related to the problem I gave you, place it in the LEFT bin with the sentence facing you. If it is not related to the problem place it in the RIGHT bin. Continue until you have sorted all the sentences in the first deck. Immediately after you have finished sorting, look up at the clock and write down your finishing time for the first deck. THEN RAISE YOUR HAND. I will then come and pick up the cards you have sorted, as well as give you a new problem to solve. Before you sort the 2nd deck, be sure to look up at the clock and write down your starting time. Sort the deck as before by placing those sentences that relate to the problem in the left bin. After sorting, be sure to look up at the clock and write down your ending time. Raise your hand again and I will give you the 3rd and final problem. Remember that you are going to be asked to write down the sentences after you have finished the 3rd deck. So read the cards as you are sorting them. Spend 15 minutes writing down the sentences you can remember. Time yourself and when 15 minutes has passed, raise your hand. I will then give you a short answer essay question to write on for 15 minutes. After 15 minutes has passed, raise your hand. The experiment will then be over!

Remember, when sorting any deck!

First: Write down your starting time.

Second: Sort the deck with those sentences which relate to the problem placed in the left bin.

Third: Look up at the clock and write down your ending time.

Fourth: Raise your hand.

Never shuffle through a pile to see what cards you have been placing in it.

Do not worry about what your neighbors are doing. They are doing something different from you, and it may take them either more or less time to complete their task than it will take you to complete yours.

Happy sorting!

Instructions for Group S

You see before you 3 decks of computer cards with sentences printed on them, a sheet of paper with 30 spaces, and a box with two bins. All decks contain the same sentences but in a different order.

Your task in this experiment is to sort cards that relate to a problem I will give you. You will sort the cards into two piles. Those sentences which seem to you to help you solve the problem, place into the bin on your left. Those sentences that do not seem to help, place into the right bin. You will then sort the second deck (which contains the same sentences) in the same manner as you did on the first deck. Now, when you sort the 3rd deck, I want you to solve the problem in the same way as you did when you sorted the second deck. In other words try to place the cards into the same piles as you did when you sorted the second deck. After you have sorted the 3rd deck, you will be asked to write down on the sheet of paper, all the sentences you can remember in any order you wish. To be good at remembering, you must <u>read</u> the cards carefully when you are sorting them.

Specific Instructions

You will be keeping the time it takes you to sort each of the decks. When I tell you to begin, look up at the clock and write down your starting time on the <u>back</u> of the paper with 30 spaces on it. Then pick up the deck on your far left and turn it over. Look at the first sentence. If it is related to the problem, place it in the LEFT bin with the sentence facing you. If it is not related to the problem place it in the RIGHT bin. Continue until you have sorted all the sentences in the first deck. Immediately after you have finished sorting, look up at the clock and write down your finishing time for the first deck. THEN RAISE YOUR HAND. I will then come and pick up the cards. Do not sort the second deck until I tell you. When sorting the second deck be sure to write down your starting and ending times, and to place those cards that relate to the problem in the left bin and the others in the right bin. After I have told you to start the 3rd deck be sure to sort the sentences into the same piles as you did when you sorted the second deck. Remember that you are going to be asked to write down the sentences after you have finished the 3rd deck. So <u>read</u> the cards as you are sorting them. Spend 15 minutes in writing down the sentences you can remember. Time yourself and when 15 minutes has passed, raise your hand. I will then give you a short answer essay question to write on for 15 minutes. After 15 minutes has passed raise your hand. The experiment will then be over!

Remember, when sorting any deck:

First: Write down your starting time.

Second: Sort the deck with those sentences which relate to the problem placed in the left bin.

Third: Look up at the clock and write down your ending time.

Fourth: Raise your hand.

Never shuffle through a bin to see what cards you have been placing in it. Do not worry about what your neighbors are doing. They are doing something different from you, and it may take them either more or less time to complete their task than it will take you to complete yours.

Happy Sorting!

Instructions for Group R

You see before you 3 decks of computer cards with sentences printed on them, a sheet with 30 spaces, and a box. All decks contain the same sentences but in a different order. Your task in this experiment is to learn the sentences on the cards. You will begin by reading each of the cards in the first deck (on your far left); and by placing each card one at a time into the box in front of you. You will then read and place the cards in the 2nd and 3rd decks in the same manner. After you have sorted the 3rd deck, you will be asked to write down on the sheet of paper all the sentences you can remember in any order you wish. To be good at remembering, you must read the cards carefully when you are sorting them.

Specific Instructions

You will be keeping the time it takes you to sort each of the decks. When I tell you to begin, look up at the clock and write down your starting time on the back of the paper with 30 spaces on it. Then pick up the deck on your far left and turn it over. Look at the first sentence, read it carefully and place it in the bin in front of you. Then look at the next sentence. Read it, and place it in the bin so that it completely covers the other card. Continue until you have placed all the cards into the bin. Immediately after you have finished, look up at the clock and write down your finishing time for the first deck. THEN RAISE YOUR HAND. I will then come and pick up the cards. Before you place the second deck, be sure to look up at the clock and write down your starting time. Then read and sort the cards and write down your ending time. Raise your hand when you finish and I will again pick up the cards. You can then start the 3rd deck.

Remember that you are going to be asked to write down the sentences after you have finished the 3rd deck. So read the cards as you are sorting them. Spend 15 minutes writing down the sentences you remember. Time yourself and when 15 minutes has passed, raise your hand. I will then give you a short answer essay question to write on for 15 minutes. After 15 minutes has passed raise your hand. The experiment will then be over!

Remember when sorting any deck:

First: Write down your starting time.

Second: Read and place the cards into the bin one at a time.

Third: Look up at the clock and write down your ending **time.**

Fourth: Raise your hand.

Never shuffle through a pile to see what cards you have been placing in it.

Do not worry about what your neighbors are doing. They are doing something different from you, and it may take them either more or less time to complete their task than it takes you to complete yours.

Happy Sorting!

Instructions for Group R-2

Read the passage again in the same way. After you have finished, I will ask you to write down (on the sheet of paper with 30 lines on it) all the points made in the chapter that you think are important. Please write them in short sentence form. Spend 15 minutes writing down the main points. Time yourself, and when 15 minutes are up raise your hand. I will then give you a short answer essay question to write on for 15 minutes. After 15 minutes has passed raise your hand. The experiment will then be over.

APPENDIX E

MEANS AND STANDARD DEVIATIONS OF EACH CELL OF THE ANALYSIS OF VARIANCE PERFORMED ON DATA OF MAIN EXPERIMENT

1. Leniently scored data
2. Strictly scored data
3. Sorting time data
4. Essay data

TABLE 25

Means and Standard Deviations for Each Cell of the 3-Way Analysis of Variance Performed on the Strictly Scored Recall Data--
Main Experiment

Subject Matter	Sex		Condition							
			C-2	C-6	M-2	M-6	S	SM	R	R-2
History	Male	M	8.75	12.50	13.00	14.50	9.75	13.50	17.00	3.67
		SD	4.99	7.77	2.45	5.75	1.71	3.32	2.45	.57
	Female	M	8.25	14.25	11.50	16.00	12.00	13.00	12.25	8.67
		SD	2.99	5.91	5.57	4.16	4.97	2.94	2.06	.57
Botany	Male	M	8.25	4.25	10.75	9.00	8.00	7.75	9.75	6.25
		SD	2.75	3.40	2.75	1.41	2.94	2.63	4.35	1.26
	Female	M	7.00	12.75	12.75	11.50	12.75	9.50	16.50	7.50
		SD	2.94	2.22	5.12	3.11	5.32	1.92	2.38	2.65
Economics	Male	M	7.75	9.25	9.75	10.25	7.00	8.00	9.25	4.67
		SD	1.50	4.11	.50	5.44	4.00	2.45	4.86	4.51
	Female	M	6.00	9.50	8.00	8.50	8.00	8.75	10.00	4.25
		SD	2.16	2.65	5.23	3.11	5.57	2.87	4.83	3.20

TABLE 26

Means and Standard Deviations for Each Cell of the 3-Way Analysis of Variance Performed on the Sorting Time Data--
Main Experiment

Subject Matter	Sex		Condition							
			C-2	C-6	M-2	M-6	S	SM	R	R-2
History	Male	M	13.25	15.50	15.50	19.25	16.75	15.75	15.00	14.33
		SD	1.50	4.80	4.51	11.93	8.18	4.03	4.69	6.66
	Female	M	15.00	11.00	12.50	13.50	13.25	10.75	12.75	12.00
		SD	4.76	2.00	2.89	3.11	5.74	3.40	3.40	1.00
Botany	Male	M	10.00	16.50	14.50	15.75	12.25	12.50	18.50	16.00
		SD	.81	2.65	5.20	1.71	5.38	6.66	8.58	4.32
	Female	M	12.00	13.50	11.50	12.75	11.75	14.00	15.50	12.75
		SD	3.56	2.65	3.70	2.87	3.59	2.58	4.04	3.59
Economics	Male	M	10.25	17.75	15.75	18.50	17.60	14.25	11.50	14.00
		SD	1.50	6.40	2.22	2.89	4.78	1.89	4.20	6.25
	Female	M	13.25	16.25	11.75	19.75	14.00	15.25	20.25	14.75
		SD	5.06	3.50	9.43	4.11	1.00	5.50	7.63	2.87

TABLE 27

Means and Standard Deviations for Each Cell of the 3-Way Analysis of Variance Performed on the Essay Data--
Main Experiment

Subject Matter	Sex		Condition							
			C-2	C-6	M-2	M-6	S	SM	R	R-2
History	Male	M	6.17	6.08	9.42	9.50	7.09	6.67	13.08	3.73
		SD	4.56	5.96	2.60	4.04	5.79	5.48	4.10	1.93
	Female	M	3.83	5.42	8.33	11.67	7.17	12.67	9.09	14.89
		SD	2.86	3.76	4.37	3.88	5.73	2.13	3.87	.70
Botany	Male	M	3.92	1.33	11.58	7.67	7.42	4.42	7.67	11.25
		SD	4.03	1.83	5.77	5.62	4.72	4.26	4.15	3.95
	Female	M	6.25	6.75	9.92	11.42	12.25	10.08	11.25	9.42
		SD	3.00	3.07	2.47	5.11	2.54	1.79	4.29	5.44
Economics	Male	M	3.00	1.42	5.36	5.42	2.40	3.67	3.08	1.78
		SD	1.98	1.29	3.66	4.42	2.44	1.63	3.37	1.84
	Female	M	3.67	2.42	7.00	4.84	4.56	3.92	6.08	2.73
		SD	1.44	1.00	4.55	2.59	2.01	2.75	5.30	1.59